NEW YORK CITY ARITHMETIC

GRADE IV

WENTWORTH-SMITH-SHIELS

4th grade – spent at Margaret Mary Kelly,
Our Lady of Mercy academy. Sept. 1933
Syosset, Long Island.

WENTWORTH-SMITH MATHEMATICAL SERIES

NEW YORK CITY ARITHMETIC

GRADE IV

BY

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PREFACE

This series of arithmetics follows exactly the official course of study prescribed for the schools of New York City. In particular, this book covers the work prescribed for Grade IV, besides affording the material necessary for a review of the leading topics of the preceding grades. In Grade IV the special work in the first half year is long division and an introduction to the operations with common fractions, and that of the second half year is the addition and subtraction of such fractions. Along with this work, however, the pupil carries on a progressive review, extending the number domain to 100,000 in the first half year, and to 1,000,000 in the second half year, and increasing his powers of operation upon numbers within these domains. For all this work the book makes ample provision.

Teachers all recognize that the greatest difficulty encountered by pupils in elementary arithmetic lies in the work in long division. On this account special attention is given to this topic. At every step the pupil is led to see a motive for his advance, and this advance is carried on by such easy stages as to remove all unnecessary difficulty and to make the operation clearly understood and easy of performance.

Next to long division the pupil has the greatest difficulty with his work in fractions. The schools have recently come to recognize, however, that much of this difficulty is unnecessary. If the pupil is required to manipulate only such fractions as are found in actual business and which he will meet in daily life, the trouble

is largely removed. Hence, in this book, except for purposes of occasional illustration, only such fractions are used as the business man would recommend. By confining the operations to these fractions, experience shows that the subject loses much of its difficulty, and the pupil gains in ability to do practical work in computation.

In Grade IV a child begins to appreciate the nature of the problem. The world outside the home and school is beginning to become more real. Human interests begin to widen, and the time arrives for a corresponding widening of the range of arithmetical problems. The standard type of isolated problem will endure, but with it will go the group of related problems, especially such as touch the life of America to-day. For a series of arithmetics by grades, intended for New York City, the problems should be urban rather than rural in nature, and problems of this type have been selected for this series. The course of study for New York City limits the applied problems in 4A to those that involve numbers of only two figures. To this rule the authors have adhered except in a few simple illustrative cases, in problems involving dollars and cents as required by the course, and in such optional problems as the teacher may use for the more ambitious pupils.

It has been the aim of the authors to present the theory with great attention to simplicity, to reach the practical by the most direct route, to show the applications of the subject to the actual environment of the child, and to furnish abundant material for oral and written work.

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NEW YORK CITY ARITHMETIC

GRADE IV. FIRST HALF

I. REVIEW

ORAL EXERCISE

1. Read aloud the following numbers:

   408 638 3460 8888 XVII

2. How many pints in 7 qt.? in 9 qt.? in 20 qt.?
3. How many quarts in 1 gal.? in 5 gal.? in 30 gal.?
4. How many quarts in 1 pk.? in 10 pk.? in 20 pk.?
5. How many inches in 2 ft.? in 10 ft.? in 100 ft.?

WRITTEN EXERCISE

Add, and also subtract:

1.	2.	3.	4.	5.	6.
95	83	82	64	75	81
86	68	49	38	27	35
7.	**8.**	**9.**	**10.**	**11.**	**12.**
45	70	92	83	76	80
26	38	75	57	38	29

ORAL EXERCISE

1. If Mary finds that eggs cost 40¢ a dozen, how much must she pay for 2 dozen eggs?

2. If butter costs 42¢ a pound, how much must Mary pay for 2 lb. of butter?

3. If oranges cost 5¢ apiece, how much must Mary pay for 4 oranges?

4. If cheese costs 20¢ a pound, how much must Mary pay for 3 lb. of cheese?

5. Mary bought 2 cans of baking powder at 40¢ a can. How much did she pay?

State the value of each of the following:

6. $4+7$.	11. $7+4$.	16. $5+8$.	21. $8+5$.
7. $11-4$.	12. $11-7$.	17. $13-5$.	22. $13-8$.
8. 4×7.	13. 7×4.	18. 5×8.	23. 8×5.
9. $28\div4$.	14. $28\div7$.	19. $40\div5$.	24. $40\div8$.
10. $\frac{1}{4}$ of 28.	15. $\frac{1}{7}$ of 28.	20. $\frac{1}{5}$ of 40.	25. $\frac{1}{8}$ of 40.

WRITTEN EXERCISE

1. Find the cost of 3 lb. of figs at 18¢ a pound.

2. How much must Mary pay for 2 qt. of sirup at 46¢ a quart? at 48¢ a quart?

3. How much must Mary pay for 3 tins of wafers at 27¢ a tin? at 24¢ a tin? at 18¢ a tin?

4. How much must Mary pay for 3 lb. of raisins at 25¢ a pound? at 23¢ a pound? at 29¢ a pound?

ORAL EXERCISE

1. How many school days in 1 week? in 2 weeks?
2. How many school days in 3 weeks? in 5 weeks?
3. How many school days in 7 weeks? in 8 weeks?
4. How many hours are you in school in the forenoon? in the afternoon? all day?
5. How many hours are you in school in 5 days?

State the value of each of the following:

6. $3 + 5$.	11. $5 + 3$.	16. $4 + 6$.	21. $6 + 4$.
7. $8 - 3$.	12. $8 - 5$.	17. $10 - 4$.	22. $10 - 6$.
8. 3×5.	13. 5×3.	18. 4×6.	23. 6×4.
9. $15 \div 3$.	14. $15 \div 5$.	19. $24 \div 4$.	24. $24 \div 6$.
10. $\frac{1}{3}$ of 15.	15. $\frac{1}{5}$ of 15.	20. $\frac{1}{4}$ of 24.	25. $\frac{1}{6}$ of 24.

WRITTEN EXERCISE

Add the following:

1.	2.	3.	4.	5.
\$2.78	\$4.87	\$17.29	\$26.48	\$34.75
3.42	6.93	14.32	42.76	41.25
4.20	8.40	.18	39.37	6.00

6.	7.	8.	9.	10.
\$1.27	\$2.97	\$19.37	\$78.25	\$57.32
2.43	3.23	23.48	49.75	49.68
4.09	5.71	4.29	33.33	81.93
.76	8.49	16.71	49.67	42.07
5.34	6.90	18.35	8.00	61.00

ORAL EXERCISE

Multiply the following:

1. 2×12.
2. 3×21.
3. 4×11.
4. 4×21.
5. 7×30.
6. 8×111.

Divide the following:

7. $24 \div 2$.
8. $240 \div 2$.
9. $440 \div 4$.
10. $505 \div 5$.
11. $810 \div 9$.
12. $999 \div 9$.

WRITTEN EXERCISE

Multiply the following:

1. 2×129.
2. 3×426.
3. 4×535.
4. 8×666.
5. 9×729.
6. 8×299.
7. 15×396.
8. 24×288.
9. 43×799.

Divide the following:

10. $112 \div 7$.
11. $322 \div 7$.
12. $552 \div 6$.
13. $328 \div 4$.
14. $777 \div 3$.
15. $968 \div 8$.
16. $405 \div 9$.
17. $504 \div 9$.
18. $888 \div 3$.

Find the values of:

19. $\frac{1}{2}$ of 16.
20. $\frac{1}{4}$ of 32.
21. $\frac{5}{8}$ of 72.
22. $\frac{1}{6}$ of 72.
23. $\frac{2}{3}$ of 36.
24. $\frac{3}{4}$ of 364.

To the Teacher. Notes in this type are intended chiefly for the teacher. There should be a review at the opening of each school year. After a vacation the pupil often finds it difficult to recall facts which he has learned. Many concrete problems should also be given. Each subject is further reviewed under the various topics.

II. READING AND WRITING NUMBERS TO 100,000

ORAL EXERCISE

1. What year is this? Write it on the blackboard.
2. What year was last year?
3. What year will next year be?
4. Count by 100's from 100 to 1000.
5. Count by 1000's from 1000 to 10,000.
6. Read the following: 30,000 = thirty thousand.
7. Read the following numbers:

40,000 50,000 70,000 90,000 100,000

WRITTEN EXERCISE

Write in figures:

1. Seventy thousand.
2. Sixty thousand.
3. Thirty thousand.
4. Fifty thousand.

Write in words:

5. 20,000.
6. 70,000.
7. 50,000.
8. 90,000.
9. 30,000.
10. 60,000.
11. 80,000.
12. 40,000.
13. 100,000.

Add, and also subtract:

14.	15.	16.	17.	18.
20,000	40,000	60,000	70,000	80,000
10,000	10,000	30,000	20,000	20,000

ORAL EXERCISE

Read the following numbers:

1.	2.	3.	4.	5.
1000	10,000	20,000	16,000	39,142
1200	12,000	28,000	16,700	76,208
1240	14,000	47,000	16,780	40,004
1248	17,000	96,000	16,786	99,999

6. What is the smallest whole number of one figure? the largest whole number of one figure?

7. What is the smallest whole number of five figures? the largest whole number of five figures?

WRITTEN EXERCISE

Write the following numbers in figures:

1. Sixteen thousand, eight hundred.

2. Twenty-seven thousand, seventeen.

3. Forty-two thousand, eighty-nine.

4. Eighty-six thousand, five hundred seven.

5. Ninety-four thousand, seven hundred sixty-one.

Write the following numbers in words:

6. 42,236.	**9.** 92,320.	**12.** 83,929.
7. 71,080.	**10.** 40,004.	**13.** 56,788.
8. 64,006.	**11.** 57,624.	**14.** 83,476.

15. Write the largest number of four figures.

16. Write the smallest number and also the largest number which you have thus far studied.

ORAL EXERCISE

Read the following statements:

1. A dealer paid $1775.50 for a car.
2. A man spent $4275.75 in building a house.
3. The city paid $27,450 for improving the park.
4. A merchant's goods are worth $75,275.50.

Read the following numbers:

5. $275.86.
6. $509.08.
7. $722.30.
8. $4287.75.
9. $9862.50.
10. $8000.70.
11. $21,346.
12. $32,879.50.
13. $68,293.75.

WRITTEN EXERCISE

Write in figures:

1. Two hundred seventy-nine dollars.
2. Five hundred dollars and sixteen cents.
3. One thousand dollars and ten cents.
4. Seventeen hundred dollars and fifty cents.
5. Nineteen hundred dollars and eighty-two cents.
6. Five thousand eight hundred sixty-three dollars and ninety-seven cents.
7. Seventy-eight thousand, three hundred thirty-nine dollars and eighty-six cents.

Teachers should call attention to the two ways of reading a number like $1975; namely, "Nineteen hundred seventy-five dollars," and "One thousand nine hundred seventy-five dollars," explaining that the former is generally used in business. Compare Exs. 5 and 6

Roman Numerals. Many years ago the Romans wrote their numbers as we see them on the faces of most clocks and watches. These are called *Roman numerals.* They are now used chiefly for numbering the chapters of books. The general system to 100 is as follows:

1 to 5:	I	II	III	IV	V
6 to 10:	VI	VII	VIII	IX	X
10's to 100:	X	XX	XXX	XL	L
	LX	LXX	LXXX	XC	C

We write certain numbers as follows:

67 = LXVII 79 = LXXIX 94 = XCIV

ORAL EXERCISE

1. The last chapter of a book which I am reading is Chapter XIV. How many chapters are there in the book?

2. If you have read all the chapters of a book up to the beginning of Chapter XVIII, how many have you read?

Read the following numbers:

3. XIX. 4. XXIX. 5. XXVII. 6. LXVI.

WRITTEN EXERCISE

Write the following numbers in Roman numerals:

1. 54. 2. 63. 3. 76. 4. 88. 5. 97.

Write the following numbers in figures:

6. LXIX. 7. LVI. 8. LXXXV. 9. XCIX.

III. ADDITION

ORAL EXERCISE

1. If you are taking apples out of a basket two at a time you would count them by 2's. Count by 2's to 50.

2. Count by 2's from 1 to 21, thus: 1, 3, 5, and so on.

3. If you take eggs out of a basket by 3's, you may count them by 3's. Count by 3's from 3 to 30.

4. Count by 3's from 1 to 31, thus: 1, 4, 7, and so on.

5. Count by 3's from 2 to 32, thus: 2, 5, 8, and so on.

6. To find the number of wheels needed for several cars, count by 4's from 4 to 40. How many wheels are needed for 7 cars? Count seven 4's. How much is 7×4?

7. Count by 4's from 1 to 21; from 2 to 22; from 3 to 23; from 4 to 24.

8. Count by 5's to 51, beginning at 1; to 52, beginning at 2; to 53, beginning at 3; to 54, beginning at 4.

WRITTEN EXERCISE

1. Write the 5's from 1 to 51; from 2 to 52; from 3 to 53; from 4 to 54.

2. Write the 6's from 6 to 60; the 7's from 7 to 70.

3. Write the 8's from 8 to 80; the 9's from 9 to 90.

4. Write the 10's from 10 to 100; from 1 to 51; from 2 to 52; from 4 to 54; from 7 to 57; from 9 to 59.

5. Write the 100's from 100 to 1000.

6. Write the 1000's from 1000 to 10,000.

ORAL EXERCISE

1. How many oranges are 1 and a half dozen more? 2 and a half dozen more? 3 and a half dozen more?

2. Add 6 to each of these numbers:

1	2	3	4	5	6	7	8	9
11	12	13	14	15	16	17	18	19

3. Count by 6's from 1 to 31, thus: 1, 7, 13, and so on.

4. Count by 6's from 2 to 32, thus: 2, 8, 14, and so on.

5. Count by 6's from 3 to 33; 4 to 34; 5 to 35.

Add the following:

6.	7.	8.	9.	10.	11.
25	37	56	60	68	68
6	6	6	20	20	24

WRITTEN EXERCISE

1. Write the 6's from 1 to 61; from 2 to 62.

2. Write the 6's from 3 to 63; 4 to 64; 5 to 65.

Add the following:

3.	4.	5.	6.	7.
329	487	595	$4.39	$7.56
66	66	666	6.60	6.06

8.	9.	10.	11.	12.
588	792	876	$5.67	$9.98
660	660	666	6.60	6.66

ORAL EXERCISE

1. Add 7 to each of these numbers:

1	2	3	4	5	6	7	8	9
21	42	53	34	75	26	87	68	99

2. Count by 7's from 1 to 71, thus: 1, 8, 15, and so on.
3. Count by 7's from 2 to 72, thus: 2, 9, 16, and so on.
4. Count by 7's from 3 to 73, thus: 3, 10, 17, and so on.
5. Count by 7's from 4 to 74; 5 to 75; 6 to 76.

Add the following:

6.	7.	8.	9.	10.	11.
25	46	57	48	480	590
7	7	7	7	70	70

WRITTEN EXERCISE

1. Write the 7's from 1 to 71; from 2 to 72.
2. Write the 7's from 3 to 73; from 4 to 74.
3. Write the 7's from 5 to 75; from 6 to 76.

Add the following:

4.	5.	6.	7.	8.
476	583	795	$8.97	$9.86
777	777	777	7.70	.77

9.	10.	11.	12.	13.
899	586	488	$7.56	$5.74
777	766	676	7.67	7.67

ORAL EXERCISE

Imagine that you have made purchases of the following amounts, and find the sums:

1.	2.	3.	4.	5.	6.
15¢	25¢	50¢	48¢	48¢	48¢
20	30	20	12	13	15

The symbol $ or ¢ written with the first number of a column applies to all the other numbers in the column. Practically the dollars and cents are usually indicated by ruled lines as in the written exercise below. This should now be explained orally by the teacher, the double line being placed at the left of the dollars.

WRITTEN EXERCISE

Imagine that a man has made purchases of the following amounts, and find the sums:

1.

7	86
2	73
4	21
5	30

2.

18	70
6	48
3	90
17	68

3.

26	30
8	
15	60
8	75

4.

15	36
14	80
7	36
	58

5.

12	83
14	67
9	86
14	70

6.

23	48
16	28
76	52
83	72

7.

17	20
23	40
82	80
76	60

8.

38	82
57	75
26	39
46	57

9.

52	70
68	92
38	56
49	28

10.

37	82
86	55
74	43
21	81

Addition. In addition the numbers which are added are called *addends*. The answer in addition is called the *sum*.

Such statements are not to be learned as formal definitions. It is merely necessary that the pupil uses the terms properly when the occasion demands it. In practical business the word "addend" is rarely used, and the word "amount" or "total" is often used for "sum."

In adding $35¢$ and $17¢$ it is easier to begin at the left, simply thinking of $45¢ + 7¢$, and similarly in many other examples in addition when the work is done orally.

We *check* the work in addition by adding in the opposite direction; if we first add a column upwards, we check by adding it downwards.

ORAL EXERCISE

Imagine that you have made purchases of the following amounts, and find the sums:

1.	2.	3.	4.	5.	6.
$60¢$	$20¢$	$30¢$	$70¢$	$60¢$	$50¢$
20	20	20	20	30	20
10	10	20	10	10	20

WRITTEN EXERCISE

Add the following:

1.	2.	3.	4.	5.
4785	8196	17,286	30,287	18,723
2934	6787	42,983	19,896	24,697
6087	5423	7,463	47,368	35,880
5423	3201	18,981	295	17,546

ORAL EXERCISE

Imagine that you have made these scores in a game, and find the total score:

1.	2.	3.	4.	5.	6.	7.
15	15	14	14	16	19	17
7	17	8	28	18	14	19

Pupils should have brief drills of this kind every day or two. This drill should be based both on the numbers written on the blackboard and on the numbers as pronounced orally.

WRITTEN EXERCISE

Add the following:

1.		2.		3.		4.		5.	
28	43	72	26	48	84	529	62	428	30
75	86	4	83	62	80	286	40	52	75
39	47	50	72	95		39	75	826	92
52	80		86	4	36	526	30	456	93
61	96	98	35	51	82	21	87	4	88

6.		7.		8.		9.		10.	
28	43	29	49	36	86	428	76	275	75
72	68	62	83	92	88	539	89	826	39
96	41	40	81	21	20	555	75	48	75
38	53	72	68	55	75	29	88	296	88
60	97		75	84	20	807	09	72	55
4	89	19	88	3	48	61	82	309	96

OPTIONAL PROBLEMS

1. In our school there are six rooms for Grade IV, the number of seats being 39, 42, 41, 40, 48, and 48. How many seats are there in all?

2. Harry wished to help his mother pay for a suit of clothes for him. In one month he made 55¢ by running errands, 50¢ by singing in a play, and $2.45 by selling papers. His mother then put in $2.05 more and bought him the suit. Find the cost of the suit.

3. Harry's mother bought the following groceries: 1 lb. of coffee, 23¢; 1 can of salmon, 14¢; 7 cakes of soap, 25¢; 1 can of peas, 11¢; 1 doz. eggs, 36¢. Find the amount which she must pay.

4. A girl in Grade IV bought the following books: reader, 30¢; geographical reader, 48¢; music book, 30¢; arithmetic, 32¢; speller, 6¢. Find the cost.

5. Mrs. Meyer furnished a bedroom as follows: brass bed, $14.75; mattress, $7.50; springs, $4.95; dresser, $6.75; rocking chair, $3.50; chair, $3.25; table, $3.75; rug, $8.50. Find the cost.

6. At an athletic meet the attendance from seven different schools was 435, 549, 234, 384, 333, 96, and 303. How many pupils from these schools attended the meet?

On pages 15 and 16 is given the first of several sets of Optional Problems, which may be used with the more ambitious pupils. The New York City course of study limits problems in this half year to those involving numbers of one or two figures. In general this limitation is recognized in this book except in these sets of Optional Problems and in a few simple cases.

7. Last year Mr. Gay spent \$480 for rent, \$924.75 for food and clothing, \$45 for pleasure, and \$38.25 for other expenses, and saved \$332. How much did he earn?

8. Mrs. White agrees to rent an apartment if the owner will put it in good condition. The owner spends \$12.50 for painting, \$8.40 for papering, \$8.50 for plumbing, \$2.75 for wiring, \$1.65 for new locks, 92¢ for shades, and \$8.70 for a gas fixture. Find the total amount spent.

9. Mrs. White moves into the apartment mentioned in Ex. 8. It costs her \$12.50 for moving her furniture, and she spends \$8.75 for oilcloth, \$11.75 for a new ice box, \$6.50 for curtains, 25¢ for picture wire, and \$40.25 for carpets. Find the sum of these expenses.

10. Sam sells 45 newspapers one week, and the next week he sells 28 more than he did the first week. How many papers does he sell in the two weeks?

11. Charles wishes to buy a basket ball. He earns \$1.25 by doing errands, his father gives him \$1, he takes \$1.75 from his bank, and his brother lends him 60¢ to make up the amount needed. How much did the ball cost?

12. Out of his spending money for the week, Benjamin spent 15¢ for moving pictures, 9¢ for candy, and 15¢ for a trip to the Zoo, and then had 36¢ left. How much was his spending money for the week?

13. Henry has a news stand. He collected from seven of his customers \$1.01, \$1.24, \$1.36, \$1.28, \$2.19, \$2, and \$1.38. He then lacked \$1.54 of enough to pay the monthly rent of his stand. How much was his rent?

IV. SUBTRACTION

Terms used in Subtraction. As we learned in Grade III, the numbers used in subtraction have special names. These names are shown in this example:

These terms are not often used outside the schoolroom, and formal definitions are unnecessary at this time. A business man is more likely to say, "Deduct what I owe and pay me the balance," or "Take out what I owe and pay me the rest," than to say, "Subtract what I owe and pay me the difference." The word "remainder" is also used for "difference," but is apt to be confused with the remainder in division.

How to Subtract. As we learned in Grade III, we perform the above subtraction in this way:

$8 + 7 = 15$, and we write the 7 below the line and add 1 to the 5 of the subtrahend, making 6.

$6 + 4 = 10$, and we write the 4 below the line and add 1 to the 2 of the subtrahend, making 3.

$3 + 5 = 8$, and we write the 5 below the line.

The difference is 547.

805 minuend
258 subtrahend
547 difference

This is the method required by the New York City course of study.

How to Check the Work. As we learned in Grade III, we check the work in subtraction by adding the answer (the difference) to the smaller number (the subtrahend). If the work is correct, the sum should be equal to the larger number (the minuend).

Pupils should always be required to check their work. Only in this way are computers certain of their results.

ORAL EXERCISE

Subtract the following:

1.	2.	3.	4.	5.	6.
12	42	16	76	13	43
7	7	8	8	6	6

7.	8.	9.	10.	11.	12.
32	32	32	41	41	41
10	12	13	11	12	15

There should be plenty of drill of this kind, a little every day or so. In particular, drill upon numbers having the same endings ($12-7$, $22-7$, $52-7$, and so on) is valuable. Pupils will find it better to begin at the left in oral subtraction; for example, in the case of $71-34$, they should simply think that $41-4=37$.

WRITTEN EXERCISE

1. The subtrahend is 286 and the minuend 405. Find the difference and show how the work is checked.

2. The subtrahend is 473 and the difference 187. Find the minuend.

Subtract, and check the work:

3.	4.	5.	6.	7.	8.
308	800	482	2438	41,283	90,000
129	327	169	1982	16,427	27,683

9.	10.	11.	12.	13.	14.
512	900	750	9000	57,008	80,000
286	451	375	2708	29,099	52,320

Making Change. If you owe a grocer \$1.30 and give him a \$2 bill, he makes change by finding the amount which, added to \$1.30, makes \$2. He does this by saying, "\$1.30 and *20* are \$1.50, and *50* are \$2," taking up 20¢ and 50¢ as he says this. He then gives you 70¢.

The pupils are doubtless familiar with this from Grade III, but the work should be reviewed frequently. It is one of the most practical features of arithmetic. Real or toy money may be used in making the operation clear to the pupils.

ORAL EXERCISE

1. Maude buys some groceries for \$1.65 and gives the dealer \$2. How much change is due?

2. Make change for \$5 when you owe \$2.50.

3. Make change for \$1, when you owe:

   35¢ 72¢ 68¢ 48¢ 22¢ 15¢

4. Make change for \$2, when you owe:

   \$1.75 \$1.45 \$1.20 \$1.85 \$1.10 \$1.15

5. Make change for \$3, when you owe:

   \$2.25 \$2.50 \$2.75 \$2.10 \$2.35 \$2.67

6. Make change for \$5, when you owe:

   \$1.25 \$1.75 \$2.10 \$3.30 \$4.70 \$3.98

7. Make change for \$10, when you owe:

   \$9.75 \$8.25 \$7.50 \$6.25 \$5.25 \$6.30

8. Make change for \$20, when you owe:

   \$15.00 \$12.25 \$17.50 \$18.75 \$19.10 \$18.10

ORAL REVIEW

Subtract each of the numbers 2, 3, 4, 5, 6, 7, 8, and 9, in turn, from each of the following numbers:

1. 41	32	63	54	75	26	87	68	39
2. 12	64	51	85	42	23	46	43	82
3. 95	52	13	36	78	61	67	48	73
4. 74	56	97	62	98	58	33	71	88

WRITTEN REVIEW

Subtract each of the following numbers from each number to the right of it, and also from each number above it:

	A	*B*	*C*	*D*	*E*
a	42,728	43,600	50,234	71,263	96,120
b	41,206	42,723	48,635	69,124	94,336
c	38,179	40,809	47,996	66,348	89,441
d	35,268	37,301	41,009	60,229	81,562
e	32,479	33,652	39,110	53,447	75,673
f	29,580	31,780	37,202	48,669	66,785
g	25,696	27,996	30,675	39,770	59,899

For example, in row *a* subtract in turn *A* from *B*, *C*, *D*, and *E*; *B* from *C*, *D*, and *E*; *C* from *D* and *E*; and *D* from *E*. In column *A* subtract in turn *b*, *c*, *d*, *e*, *f*, and *g* from *a*; *c*, *d*, *e*, *f*, and *g* from *b*; *d*, *e*, *f*, and *g* from *c*; *e*, *f*, and *g* from *d*; *f* and *g* from *e*; and *g* from *f*. Check each subtraction.

All such review work should be discontinued the moment the children show mastery of the particular subject in hand.

Subtraction of Money. If Mr. Brown has \$247.50 and spends \$176.75 of it for some furniture, how much money has he left?

We must take \$176.75 from \$247.50.

\$247.50
176.75
\$70.75

The teacher should develop the work substantially as follows:

We write the numbers as here shown.
We see that $5 + 5 = 10$. We write the 5 below.
We see that $8 + 7 = 15$. We write the 7 below.
We now write the decimal point.
We see that $7 + 0 = 7$. We write the 0 below.
We see that $7 + 7 = 14$. We write the 7 below.
We see that $2 + 0 = 2$. So there are no hundreds of dollars.
The result is \$70.75, and so Mr. Brown has \$70.75 left.

In subtracting United States money, write the numbers so that the decimal points are in a column and subtract.

WRITTEN EXERCISE

Subtract, and check the work:

1.	2.	3.	4.
\$72.41	\$29.84	\$94.76	\$60.70
24.92	12.97	76.98	55.81
5.	**6.**	**7.**	**8.**
\$50.01	\$65.42	\$90.08	\$52.86
20.09	59.97	25.19	23.94
9.	**10.**	**11.**	**12.**
\$341.65	\$341.65	\$341.65	\$341.65
120.40	170.40	170.46	173.46

ORAL EXERCISE

Subtract the following:

1.	2.	3.	4.	5.
\$3.60	\$3.09	\$3.69	\$3.65	\$5.75
.10	.04	.14	1.14	2.14

6.	7.	8.	9.	10.
\$5.95	\$4.65	\$5.55	\$8.75	\$8.96
1.20	1.10	4.44	.25	1.96

WRITTEN EXERCISE

Subtract, check the work, and time yourself:

1.	2.	3.	4.	5.
\$76.29	\$85.36	\$76.29	\$14.36	\$70.24
75.37	6.87	62.89	5.63	10.65

6.	7.	8.	9.	10.
\$96.73	\$88.41	\$95.27	\$33.42	\$47.63
77.96	79.52	9.86	9.29	8.24

11.	12.	13.	14.	15.
\$26.96	\$60.00	\$21.40	\$40.00	\$90.00
17.27	42.36	17.52	5.75	36.27

16.	17.	18.	19.	20.
\$24.00	\$32.09	\$41.32	\$68.03	\$75.00
.78	16.70	28.75	49.26	.69

OPTIONAL PROBLEMS

1. Emma's mother bought her a new coat. Emma saw her give the dealer a \$20 bill and receive \$11.51 in change. Emma could then tell how much the coat cost. How much was it?

2. The four sides of a city park measure 792 ft., 1320 ft., 780 ft., and 1326 ft. When Rebecca and Ruth walked round the park how many feet did they walk? This was how much more or less than the 5280 ft. in 1 mile?

It will be seen that both addition and subtraction are involved in this example and most of the following examples in this exercise.

3. Minnie goes to the store and pays 32¢ for eggs, 8¢ for milk, and 36¢ for butter. She also pays the dealer \$1.94 which her mother owed. How much change should she receive from a \$5 bill?

4. The 4A and 4B classes had running contests every school day for a week. The 4A score was 18, 16, 9, 17, and 23, and the 4B score 15, 16, 14, 17, and 18. What is the difference in the scores of the two classes?

5. Richard has \$3.40 in the bank, and he earns \$1.50 more by working on Saturdays. How much must his father add to these two amounts so that Richard may have enough money to buy a suit of clothes costing \$8.75.

6. Mary's mother gives her 50¢ with which to entertain her friends. Mary pays 18¢ for a jar of jam, 4¢ for a box of crackers, 8¢ for a quart of milk, and 9¢ for some snapping mottoes. She also wishes to buy a cake for 20¢. How much more money does she need to buy the cake?

7. A school entertainment is to be given in a hall which seats 720 persons. If 160 seats are reserved for visitors and 374 for pupils of the upper grades, how many will be left for pupils of the lower grades?

8. A man in a lunch room ordered a steak costing 50¢, a baked potato costing 10¢, some ice cream costing 15¢, and a cup of coffee costing 5¢. He gave the waiter 10¢ as a tip. How much change was left from a $2 bill?

9. A schoolroom is 20 ft. wide and 28 ft. long. How many feet of picture molding are needed to go round the room, deducting 16 ft. for doors and windows?

10. Peter's mother has $24 a week with which to run the house. If she spent $5.40 last week for rent, $6.50 for food, 75¢ for gas, and $4.50 for clothing, how much had she left from her week's allowance?

11. If Rachel paid 23¢ for some steak, 16¢ for some soup meat, and 12¢ for a can of tomatoes, and gave the dealer a $2 bill, how much change should she get?

12. Tony's father drives an ice wagon. He started out one morning with 2400 lb. of ice, and had 90 lb. left after delivering 2120 lb., the rest being lost by cutting and melting. How many pounds of ice were lost?

13. One day Tony's father started out with 2400 lb. of ice and delivered 2150 lb. He lost 70 lb. by cutting and melting. How many pounds did he have left?

These examples are the kind that pupils in a city school will meet. They require a little more thought than the ordinary problem, and care should be taken not to give too many in one lesson. The pupils should be encouraged to bring such problems to class.

V. MULTIPLICATION

ORAL REVIEW

1. Count by 2's from 2 to 24. Then recite the multiplication table of 2's from 1×2 to 12×2.

2. Count by 3's from 3 to 36. Then recite the multiplication table of 3's from 1×3 to 12×3.

3. Count by 4's from 4 to 48. Then recite the multiplication table of 4's from 1×4 to 12×4.

4. Count by 5's from 5 to 60. Then recite the multiplication table of 5's from 1×5 to 12×5.

State rapidly the following products:

5.	4×5	9×3	6×2	7×4	8×5
6.	8×4	6×5	8×2	7×3	9×4
7.	7×5	7×2	8×3	9×2	11×4
8.	6×3	12×3	12×5	12×4	12×2

WRITTEN REVIEW

1. Write all the multiplication tables mentioned in Exs. 1–4 above.

2. Write the division tables that come from the tables in Ex. 1 of this exercise.

Multiply the following:

3.	**4.**	**5.**	**6.**	**7.**
225	334	234	435	504
4	7	28	36	68

ORAL REVIEW

1. Count by 6's from 6 to 72. Then recite the multiplication table of 6's from 1×6 to 12×6.

2. Count by 7's from 7 to 84. Then recite the multiplication table of 7's from 1×7 to 12×7.

3. Count by 8's from 8 to 96. Then recite the multiplication table of 8's from 1×8 to 12×8.

4. Count by 9's from 9 to 108. Then recite the multiplication table of 9's from 1×9 to 12×9.

5. Count by 10's from 10 to 120. Then recite the multiplication table of 10's.

State rapidly the following products:

6.	9×6	9×9	6×7	8×8	7×7
7.	9×8	8×6	8×9	5×8	7×9
8.	6×9	6×6	7×6	8×7	12×4
9.	9×7	6×8	12×8	12×6	12×7

WRITTEN REVIEW

1. Write all the multiplication tables mentioned in Exs. 1–5 above.

2. Write all the division tables that come from the tables in Ex. 1 of this exercise.

Multiply the following:

3.	**4.**	**5.**	**6.**	**7.**
427	535	268	529	667
26	48	37	29	78

Table of 11's. Although we can multiply by 11 as we multiply by any other number of two figures, it is convenient to know the multiplication and division tables of 11's.

ORAL EXERCISE

1. How much is 11¢ and 11¢?
2. How much is 22¢ and 11¢?
3. Add 33 in. and 11 in.; 44 ft. and 11 ft.
4. Count by 1's to 12, and by 11's to 132, thus:

1	2	3	4	5	6	7	8	9	10	11	12
11	22	33	44	55	66	77	88	99	110	121	132

5. How much is five 11's? seven 11's? ten 11's?
6. Read and learn this table:

$1 \times 11 = 11$	$5 \times 11 = 55$	$9 \times 11 = 99$
$2 \times 11 = 22$	$6 \times 11 = 66$	$10 \times 11 = 110$
$3 \times 11 = 33$	$7 \times 11 = 77$	$11 \times 11 = 121$
$4 \times 11 = 44$	$8 \times 11 = 88$	$12 \times 11 = 132$

7. Read and learn this table:

$11 \div 11 = 1$	$55 \div 11 = 5$	$99 \div 11 = 9$
$22 \div 11 = 2$	$66 \div 11 = 6$	$110 \div 11 = 10$
$33 \div 11 = 3$	$77 \div 11 = 7$	$121 \div 11 = 11$
$44 \div 11 = 4$	$88 \div 11 = 8$	$132 \div 11 = 12$

State the values of the following:

8.	7×11	11×6	11×12	11×11
9.	5×11	$55 \div 11$	$66 \div 11$	$77 \div 11$
10.	8×11	$99 \div 11$	$132 \div 11$	$121 \div 11$

Terms Used. We have already learned that when we take a number 2 times we multiply it by 2, that when we take it 3 times we multiply it by 3, and so on.

We have also learned the terms used in multiplication. These are *multiplicand*, *multiplier*, and *product*, and are seen in the next example.

Pupils are not expected to learn formal definitions at this stage. The important thing is that the terms are properly used.

Multiplying Money. If a bookseller sells 7 books at \$1.25 each, how much money does he receive for them?

We see that we must multiply \$1.25 by 7.

The teacher should develop the work substantially as follows:

We first see that $7 \times 5¢ = 35¢$, or 3 dimes and 5 cents, and we write the 5 in the cents' place and add the 3 to the dimes.

\$1.25 multiplicand
7 multiplier
\$8.75 product

Then 7×2 dimes $= 14$ dimes, and 14 dimes $+ 3$ dimes $= 17$ dimes, or \$1.70. We write the 7 in the dimes' place and add the 1 to the dollars.

We then write the decimal point, to separate the dollars from the dimes.

Then $7 \times \$1 = \$7$, and $\$7 + \$1 = \$8$, and we write the 8 in the dollars' place.

The product is \$8.75, and so the bookseller receives \$8.75.

Therefore, *to multiply money, multiply as with whole numbers, placing the decimal point in the product below the decimal point in the multiplicand.*

The pupils are not expected to repeat an explanation like the one given above. The important thing is that they understand the process clearly so that they can do the work easily.

WRITTEN EXERCISE

1. A boy subscribes for a magazine for each of his three cousins. At $2.25 each, how much did he have to pay?

2. A tennis club bought 4 rackets at $1.50 each. How much did the rackets cost?

3. Eight boys went on a camping trip. Each paid $2.80 for his railway ticket. How much did they all pay?

4. On a camping trip each of eight boys put in $7.50 for camp expenses. How much did they all contribute?

5. A mother bought 5 pairs of shoes for her children, paying $1.75 a pair. How much did the shoes cost?

6. Ralph's father is a furniture dealer. He bought 6 dressers and paid $9.75 for each of them. How much did he pay for them all?

7. Ralph's father also bought 9 sideboards at $26.50 each. How much did he pay for them all?

Multiply the following:

8.	9.	10.	11.	12.
$3.65	$3.65	$3.65	$15.92	$106.15
7	17	37	37	4

13.	14.	15.	16.	17.
$2.87	$4.96	$8.06	$18.92	$104.38
48	43	46	36	8

The statement in the New York course of study that problems are limited to those involving numbers not exceeding two figures evidently does not exclude numbers involving dollars and cents.

Short Method of Multiplying by 11. If we multiply 48 by 11 in the ordinary way the work is done as here shown. We see that the ones' figure is 8; that the tens' figure is found by taking the sum of $4 + 8$; and that the hundreds' figure is found by adding to 4 the 1 that comes from the column of $4 + 8$.

$$\begin{array}{r} 48 \\ 11 \\ \hline 48 \\ 48 \\ \hline 528 \end{array}$$

This makes it easy to multiply by 11. For example, to find the product of 11×48 we have 8 for the ones, $8 + 4$, or 12, for the tens, and $4 + 1$, or 5, for the hundreds, making 528.

Teachers may make this work very interesting by showing other methods of multiplying by 11, or by letting the pupils discover them. For example, from the table of 11's we can multiply as with a one-figure multiplier, thus, to multiply 48 by 11, we have $11 \times 8 = 88$, or 8 ones + 8 tens; then $11 \times 4 = 44$, and $44 + 8 = 52$, making the product 528. Or, we may simply write the multiplicand twice, as here shown, and add. This is a quick way, it being unnecessary to write the multiplicand and multiplier as usual.

$$\begin{array}{r} 48 \\ 48 \\ \hline \end{array}$$

WRITTEN EXERCISE

Multiply by 11:

1. 46.	**3.** 63.	**5.** 37.	**7.** 77.	**9.** 91.
2. 52.	**4.** 29.	**6.** 58.	**8.** 82.	**10.** 99.

11. If there are 2 doz. colored crayons in a box, how many crayons are there in 11 such boxes?

12. If the school buys 11 teachers' desks at \$14 each, how much does it pay for them all?

13. If 11 boys take a railway trip, each paying \$1.15 for his ticket, how much do the tickets cost?

Table of 12's. It is also convenient to learn the multiplication and division tables of 12's. This is of use to us in measuring, because in 1 ft. there are 12 in.

ORAL EXERCISE

1. Count by 2's to 24, and by 12's to 144, thus:

2	4	6	8	10	12	14	16	18	20	22	24
12	24	36	48	60	72	84	96	108	120	132	144

2. How many are five 12's? How many inches in 5 ft.?

3. How many are six 12's? How many inches in 6 ft.?

4. Read and learn this table:

$1 \times 12 = 12$	$5 \times 12 = 60$	$9 \times 12 = 108$
$2 \times 12 = 24$	$6 \times 12 = 72$	$10 \times 12 = 120$
$3 \times 12 = 36$	$7 \times 12 = 84$	$11 \times 12 = 132$
$4 \times 12 = 48$	$8 \times 12 = 96$	$12 \times 12 = 144$

5. Read and learn this table:

$12 \div 12 = 1$	$60 \div 12 = 5$	$108 \div 12 = 9$
$24 \div 12 = 2$	$72 \div 12 = 6$	$120 \div 12 = 10$
$36 \div 12 = 3$	$84 \div 12 = 7$	$132 \div 12 = 11$
$48 \div 12 = 4$	$96 \div 12 = 8$	$144 \div 12 = 12$

State the values of:

6. 7×12 12×9 $48 \div 12$ $96 \div 12$ $108 \div 12$

7. 8×12 12×11 $120 \div 12$ $132 \div 12$ $144 \div 12$

8. How many inches in 7 ft.? in 9 ft.? in 11 ft.?

9. At 12¢ a package, how much will 4 packages of cornstarch cost? 5 packages? 7 packages? 12 packages?

Convenient Products. Besides the products already learned in the multiplication table, there are others which it is convenient to know. Some of these are as follows:

$2 \times 13 = 26$	$2 \times 19 = 38$	$2 \times 25 = 50$
$2 \times 14 = 28$	$2 \times 20 = 40$	$3 \times 12 = 36$
$2 \times 15 = 30$	$2 \times 21 = 42$	$3 \times 13 = 39$
$2 \times 16 = 32$	$2 \times 22 = 44$	$3 \times 14 = 42$
$2 \times 17 = 34$	$2 \times 23 = 46$	$3 \times 15 = 45$
$2 \times 18 = 36$	$2 \times 24 = 48$	$3 \times 16 = 48$

This list gives products to 50, excepting those found in the multiplication table usually studied. The word *factor* may be used, but no formal definition is necessary at this time.

ORAL EXERCISE

1. How much will 2 melons cost at 15¢ each?

2. How many eggs are there in 8 doz. eggs?

3. How much will 2 yd. of cloth cost at 18¢ a yard?

4. A schoolroom is 19 ft. long. What is the length of the two sides? If the room is 16 ft. wide, what is the length of the two ends?

5. At 24¢ a dozen, how much will 2 doz. eggs cost?

6. If you wish to buy 3 grapefruits, and they cost 14¢ each, how much must you pay for them all?

State the products of the following:

7. 2×14	2×17	2×20	2×18
8. 2×16	2×23	2×19	2×25
9. 3×15	3×13	5×12	3×14

Multiplication Continued. The products learned on page 32 are conveniently used in ordinary multiplication. For example, if we have to multiply 168 by 3 we think of the work as follows: "$3 \times 8 = 24$, $3 \times 16 + 2 = 48 + 2 = 50$."

$$\begin{array}{r} 168 \\ \times\ 3 \\ \hline 504 \end{array}$$

By this means we can often multiply numbers of three figures without using pencil and paper.

Consider also such cases as 2×716 and 3×814.

ORAL EXERCISE

Multiply the following:

1.	2.	3.	4.	5.	6.
12	120	16	160	13	130
2	2	2	2	3	3
7.	**8.**	**9.**	**10.**	**11.**	**12.**
15	151	14	143	16	162
3	3	3	3	3	3

WRITTEN EXERCISE

Multiply the following:

1.	2.	3.	4.	5.	6.
716	914	616	517	517	614
3	3	2	2	22	23
7.	**8.**	**9.**	**10.**	**11.**	**12.**
316	415	417	713	524	416
123	132	212	133	122	132

ORAL EXERCISE

1. If 2 strips of carpet are needed for a hall that is 15 ft. long, how many feet of carpet are needed in all? How many yards are needed for the hall?

2. If 3 strips of carpet are needed for a room 14 ft. long, how many feet of carpet are needed in all? How many yards are needed for the room?

State two numbers whose product is:

3. 30.	**5.** 40.	**7.** 50.	**9.** 38.	**11.** 45.
4. 34.	**6.** 46.	**8.** 39.	**10.** 42.	**12.** 50.

The pupils should be encouraged to give more than one answer whenever this is possible. Thus $48 = 6 \times 8 = 3 \times 16 = 2 \times 24$. Only multiplication by whole numbers greater than 1 is expected.

WRITTEN EXERCISE

Multiply the following:

1.	**2.**	**3.**	**4.**	**5.**
4728	3786	11,342	$186.40	$102.50
19	23	7	4	9
6.	**7.**	**8.**	**9.**	**10.**
2476	1976	48,987	$107.62	$109.75
35	47	2	7	8
11.	**12.**	**13.**	**14.**	**15.**
1098	5280	17.356	$321.48	$107.87
69	17	5	2	7

Multiplying by 10 and 100. As you have learned in Grade III, there is a short way of multiplying by 10 and a short way of multiplying by 100. We know that

$10 \times 4 = 40$ $\qquad$ $100 \times 7 = 700$
$10 \times 15 = 150$ $\qquad$ $100 \times 27 = 2700$

That is, *to multiply a number by 10, annex 0 to the number; to multiply by 100, annex two 0's.*

ORAL EXERCISE

1. At \$75 each, how much will 10 typewriters cost?

2. At \$875 each, how much must a dealer pay for 100 automobiles?

3. Multiply 50 by 10; by 100.

Multiply the following by 10:

4. 72.	9. 527.	14. \$127.	19. \$10.
5. 36.	10. 632.	15. \$204.	20. \$257.
6. 48.	11. 871.	16. \$333.	21. \$627.
7. 79.	12. 900.	17. \$560.	22. \$812.
8. 80.	13. 909.	18. \$880.	23. \$1255.

Multiply the following by 100:

24. 25.	29. 100.	34. \$3.	39. \$20.
25. 32.	30. 225.	35. \$7.	40. \$375.
26. 50.	31. 303.	36. \$625.	41. \$627.
27. 75.	32. 490.	37. \$901.	42. \$928.
28. 99.	33. 876.	38. \$575.	43. \$300.

WRITTEN EXERCISE

1. A dealer buys 36 typewriters at $75 each. How much do they cost him?

2. In a yard there are 36 in. How many inches are there in 3 yd.? in 6 yd.? in 15 yd.?

3. A merchant pays $95 a month for rent of his store. How much does he pay in 6 mo.? in a year?

4. A man pays $75 a month for rent of his apartment. How much does he pay in 6 mo.? in a year?

Multiply the following:

5. 24×762.	18. 123×286.	31. 15×4783.
6. 28×631.	19. 138×560.	32. 18×3026.
7. 39×648.	20. 109×668.	33. 17×2989.
8. 37×567.	21. 149×609.	34. 24×2668.
9. 40×760.	22. 286×286.	35. 37×1989.
10. 46×829.	23. 265×370.	36. 48×1067.
11. 53×726.	24. 237×389.	37. $8 \times 10{,}286$.
12. 56×620.	25. 241×286.	38. $9 \times 10{,}067$.
13. 67×876.	26. 169×346.	39. $3 \times 19{,}786$.
14. 65×557.	27. 177×268.	40. $4 \times 20{,}178$.
15. 72×489.	28. 225×360.	41. $28 \times \$15.42$.
16. 76×600.	29. 239×371.	42. $43 \times \$17.67$.
17. 83×426.	30. 200×400.	43. $57 \times \$11.24$.

Use only so much of such drill work as is necessary to assure accurate and reasonably rapid work.

How to Solve a Problem. We have worked many examples in arithmetic, usually with only one addition, or one subtraction, or one multiplication, or one division. When we have more than one such operation we have to think first of how we are going to solve the problem, and then of how we are going to write out our work. Let us look at such a problem:

An automobile dealer bought 7 touring cars at $1450 each and 12 runabouts at $675 each. How much did he pay for them all?

The teacher should now explain that we have first of all to see exactly what is given; then exactly what we wish to find; and finally, how we shall go to work to find it. Most errors in solution come from failing to see clearly the first two of these things. Ask exactly what is first given — the cost of one touring car and the number of cars. What is first required? The cost of 7 touring cars. How shall we go about to find this? Similarly take up the next two steps — the cost of the runabouts and the total cost of all the cars. Then have the actual computation put down, followed by the statement of the solution. Have the pupils perform the multiplication by 12 by the table of 12's. Explain the abbreviation *Ans.*, and state the desirability of using it. The dollar signs may be omitted in the computation, as a business man would omit them.

1450	675	10150
7	12	8100
10150	8100	18250

The cost of 7 touring cars is $7 \times \$1450$, or $10,150.
The cost of 12 runabouts is $12 \times \$675$, or $8100.
The total cost is $\$10,150 + \$8100$, or $18,250. *Ans.*

WRITTEN REVIEW

1. A dealer bought 18 typewriters at \$85 each and 3 at \$75 each. How much did he pay for them all?

2. A dealer bought 16 gas fixtures at \$4.25 each and 14 others at \$3.90 each. How much did he pay in all?

3. A school bought 48 desks at \$6.75 each and 32 smaller ones at \$5.60 each. How much did it pay for them all?

4. A dealer bought 24 barrels of flour. If each barrel contained 196 lb., how many pounds of flour did he buy?

5. A grocer bought 28 baskets of apples, each basket containing 48, and 16 baskets of larger apples, each basket containing 36. How many apples did he buy?

6. A dealer bought 24 arithmetics at 30¢ each and 48 notebooks at 14¢ each. How much did he pay for them all?

It may be necessary to remind the pupils again that 30¢ may be written \$0.30, and that this is a convenient form for multiplying.

7. A dealer bought 18 chairs at \$2.75 each and 144 chairs at \$1.96 each. How much did he pay in all?

8. A dealer bought two large stoves at \$57 each and a small one for \$25. How much did he pay for them all?

9. A man pays \$80 a month for his apartment, and \$28 a month for a cook. How much does he pay in a year for the apartment and the cook?

Teachers should encourage originality of attack in such a problem. Some pupils will take 12 times the sum of \$80 and \$28, while others will find the sum of $12 \times \$80$ and $12 \times \$28$. The two may then be compared as to economy of time and effort.

OPTIONAL PROBLEMS

1. Find the yearly rent of a flat at \$28.50 a month.

2. A class of 37 boys went to an athletic meet. Each boy spent 25¢ for carfare and ticket. What were the expenses of the whole class?

3. Harry's older brother says that his wages are too small to let him buy his mother a present, and yet he spends on an average 7¢ a day for tobacco. How much does he spend for tobacco in a year of 365 da.?

If necessary, consider again the meaning of the word *average.* Remind the pupils that, although the problem leads us to multiply 7¢ by 365, and then express the result as dollars and cents, we practically multiply 365 by 7, call the result cents, and then express this as dollars and cents.

4. A family takes a newspaper which costs 2¢ every week day and 5¢ on Sunday. How much is the cost for a month of March in which there are 5 Sundays?

5. A conductor on a trolley car collects 89 fares on a downtown trip and 47 fares coming back. If each fare is 5¢, how much money does he collect on both trips?

6. Instead of paying 36¢ a pound for butter, Mrs. Sinclair decides to buy oleomargarine at 23¢ a pound. If the family uses 156 lb. a year, how much money is saved by buying oleomargarine instead of butter?

7. Mrs. Sinclair has been paying 29¢ a can for soup. She finds that she can get this soup at \$3.25 per dozen cans. How much will she save on 24 cans if she buys them by the dozen?

8. If you need shades and curtains for your home, and if, for each window, the shade costs 28¢ and the curtain 48¢, how much will the shades and curtains cost for 6 windows?

9. Nora's mother wants to buy a piano. The dealer tells her that she can have one for $25 down and $7.50 a month for 2 yr. How much will the piano cost?

Teachers should explain the meaning of such expressions as "$25 down." This problem illustrates a common way of selling house furnishings, and similar problems should be suggested by the pupils.

10. Kate finds that she can save 25¢ on every dollar record for her victrola by going to a certain department store. If she buys a dollar record every two weeks for 48 wk., how much will she save by going to this store?

Pupils should be encouraged to bring similar problems to class.

11. Jane's father and her two older brothers each use a clean shirt twice a week. If the laundry charges 12¢ for each shirt, how much is their laundry bill for 52 wk.?

12. A certain school allows each pupil a new pencil twice a term. If there are 29 classes, averaging 41 pupils each, how many pencils are given out in a term?

13. After selling 127 copies of a weekly paper at 5¢ a copy, a boy found that he had $6.25. Was this the amount taken in, or had he lost some?

14. In a telephone booth open 12 hr. a day there is an average number of 13 messages an hour. At 5¢ per message, what are the receipts of that booth per day?

VI. DIVISION

Remainder in Division. If you have 23¢, how many oranges can you buy at 5¢ each, and how much money will you have left over?

We know that 4 fives are 20, so $23 \div 5 = 4$, and there is 3 left over. So we see that we can buy 4 oranges, and there will be 3¢ left over.

$$5\overline{)23}$$
$$4$$
3 remainder

We say that 23 is not exactly divisible by 5, and that the *quotient* is 4 and the *remainder* is 3.

If there is no remainder, the division is said to be *exact*.

ORAL EXERCISE

State rapidly the quotients and remainders:

1. $10 \div 3$.
2. $13 \div 4$.
3. $32 \div 3$.
4. $11 \div 3$.
5. $42 \div 4$.
6. $25 \div 3$.
7. $41 \div 5$.
8. $47 \div 4$.

WRITTEN EXERCISE

1. At 5¢ each, how many oranges can you buy with 57¢, and how much money will you have left?

2. At 6¢ a pound, how many pounds of sugar can you buy with 43¢, and how much money will you have left?

3. At 2¢ each, how many postage stamps can you buy with 25¢, and how much money will you have left?

Divide, giving the quotients and remainders:

4. $45 \div 2$.
5. $35 \div 3$.
6. $67 \div 2$.
7. $34 \div 3$.

ORAL DRILL IN DIVISION

Divide each of the following numbers by 2, 3, 4, and 5, in turn, giving quotients and remainders, taking first the lines 1–3 and then the columns 4–13:

	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1.	21	39	26	50	46	56	28	44	40	30
2.	38	34	51	31	22	45	59	55	49	35
3.	25	48	32	47	41	57	42	60	23	43

Divide, as above, each of the following numbers by 6, 7, 8, and 9, in turn, giving quotients and remainders:

	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.
14.	10	16	19	17	20	18	21	24	23	22
15.	13	51	44	50	31	41	57	48	52	40
16.	15	42	29	59	26	65	47	32	64	61

WRITTEN EXERCISE

Divide each of the following numbers by 2, 3, 4, 5, 6, 7, 8, and 9, in turn, giving quotients and remainders:

1.	125	243	627	481	936	829
2.	352	301	278	270	633	639
3.	473	486	907	842	568	781
4.	597	700	741	488	777	666

Teachers should clearly understand that drill pages of this kind are to be used only until the pupil has attained sufficient proficiency in the processes. The drill should then be discontinued and new work should be taken up.

ORAL EXERCISE

1. How many 10's are there in 20? in 30? in 150?
2. Do you see an easy way of dividing by 10?
3. Divide each of these numbers by 10:

   160 210 230 340 480 560 750

4. How many 2's in 4? How many 20's in 40?
5. Do you see an easy way of dividing by 20?
6. Do you see an easy way of dividing by 30?

Dividing by 10's. In dividing 240 by 20 we may cancel the 0's in 20 and 240, and simply divide 24 by 2 as here shown.

$$2\cancel{0})24\cancel{0}$$
$$12$$

The quotient is 12.

WRITTEN EXERCISE

Divide the following numbers by 20:

1. 120 140 180 260 380 540 780
2. 220 240 280 460 720 820 940

Divide the following numbers by 30:

3. 120 240 360 390 420 450 480
4. 510 570 630 690 720 810 960

Divide the following:

5. $560 \div 40$.
6. $750 \div 50$.
7. $360 \div 60$.
8. $720 \div 60$.
9. $960 \div 60$.
10. $1440 \div 60$.
11. $2340 \div 90$.
12. $1400 \div 700$.
13. $9600 \div 800$.

Fraction in the Quotient. If we divide 4162 by 3, we find that the quotient is 1387 with remainder 1. If we divide this remainder by 3, we have $\frac{1}{3}$. We may write this $\frac{1}{3}$ in the quotient.

$$3\overline{)4162}\quad 1387\tfrac{1}{3}$$

If we divide 4163 by 10, we see that the remainder is 3, the last figure in the number divided. The quotient is then $416\frac{3}{10}$. We write the work as here shown.

$$10\overline{)4163}\quad 416\tfrac{3}{10}$$

The case involving the reduction of a fraction in a quotient is considered later. It is better to take one difficulty at a time. The check in division when a remainder is involved is also considered later.

WRITTEN EXERCISE

1. If 900 oranges are to be packed in 7 boxes of equal size, how many oranges will go in each box, and how many oranges will be left over?

Find the quotients, and write the remainders as fractions:

2. $4173 \div 4$.
3. $6131 \div 5$.
4. $4237 \div 6$.
5. $8195 \div 7$.
6. $2575 \div 8$.
7. $3241 \div 9$.
8. $6871 \div 5$.
9. $8233 \div 4$.
10. $4673 \div 8$.
11. $6793 \div 4$.
12. $4127 \div 2$.
13. $8345 \div 6$.
14. $9281 \div 5$.
15. $8196 \div 7$.
16. $4237 \div 8$.
17. $3496 \div 9$.
18. $7843 \div 6$.
19. $8207 \div 5$.
20. $3267 \div 8$.
21. $9725 \div 6$.
22. $4195 \div 9$.
23. $6464 \div 9$.
24. $5072 \div 3$.
25. $4352 \div 7$.
26. $8773 \div 8$.
27. $5225 \div 4$.
28. $8231 \div 10$.

ORAL EXERCISE

1. How much is 9×10? $90 \div 9$? $90 \div 10$?
2. How much is 9×11? $99 \div 9$? $99 \div 11$?
3. How much is 10×11? $110 \div 10$? $110 \div 11$?

State the following products and quotients:

4.	4×11	$44 \div 4$	$44 \div 11$	$88 \div 11$
5.	7×11	$77 \div 7$	$77 \div 11$	$66 \div 11$

Name two numbers whose product is:

6. 26. **7.** 34. **8.** 38. **9.** 42. **10.** 39.

Drill also upon the other products studied on page 32.

11. If we divide 34 by 11, what is the quotient and what is the remainder?

Divide each of the following numbers by 11, stating the quotient and also the remainder, if any:

12.	33	34	35	37	39	40
13.	44	46	47	49	50	54
14.	66	69	70	71	73	76
15.	22	220	330	331	442	556

16. If the school has to pay \$11 for a teacher's desk, how many desks can it buy for \$25, and how much money will it have left?

17. If the school has to pay \$4 for a pupil's desk, how many desks can it buy for \$25, and how much money will it have left?

18. If a dealer in school desks has to pay \$3 for a pupil's desk, how do you find how many desks he can buy for \$200, and how much money he will have left?

The pupil is not expected to perform the operation mentally. The purpose of this oral question and of those immediately following is to lead him to see the importance of extending his knowledge to long division.

19. If the dealer mentioned in Ex. 18 has to pay \$11 for a teacher's desk, and has \$200 with which to buy a number of such desks, how do you find how many desks he can buy for \$200, and how much money he will have left? Can you do this work yet? Could you do it if the price of each desk was \$10 instead of \$11?

Divide by 11 such of the following numbers as you can easily divide without pencil and paper, and divide the others on paper after you have studied the next page:

20.	44	440	4400	5555	6600
21.	77	770	7700	8877	9900
22.	24	221	7705	5507	6609
23.	98	451	7810	6831	7296
24.	66	660	6666	6644	4466
25.	22	220	2244	4422	2288
26.	33	330	3430	3443	3454
27.	55	551	5500	5610	5621
28.	68	662	6600	6710	6721
29.	88	883	8800	8811	8921
30.	99	997	9999	9911	8932

Long Division. If a dealer pays \$154 for 11 boys' suits, how much does he pay for each suit?

For each suit he must pay \$154 ÷ 11, so we need to know how to divide \$154 by 11. In such a division we need not write the dollar sign (\$).

The following shows the work which we do:

Divide,	$15 \div 11$
Multiply,	1×11
Subtract; then	$44 \div 11$
Multiply,	4×11
Subtract; no remainder.	

Written Work	Check
14	14
11)154	11
11	154
44	
44	

The teacher should put this work on the blackboard, explain what is done in each step, show the pupil what he is expected to write (Written Work), and explain the check. Although short division should be used in dividing by 11, this is the best divisor for the purpose of introducing long division.

WRITTEN EXERCISE

Divide each of these numbers by 11:

1. 121.	3. 1221.	5. 1331.	7. 4741.	9. 2541.
2. 132.	4. 1232.	6. 1441.	8. 3531.	10. 7887.

11. At \$11 each, how many football suits can a dealer buy for \$715? for \$726? for \$836?

12. At \$11 each, how many Boy Scout suits can a dealer buy for \$242? for \$352? for \$363?

13. If 11 girls together weigh 638 lb., what is their average weight?

Two-Figure Divisor. A piano manufacturer sold 21 pianos for $7161. How much did he receive for each piano?

We see that we must divide $7161 by 21.

Before we divide, it is a good plan, at first, to write out a table of 21's, as follows:

$1 \times 21 = 21$	$4 \times 21 = 84$	$7 \times 21 = 147$
$2 \times 21 = 42$	$5 \times 21 = 105$	$8 \times 21 = 168$
$3 \times 21 = 63$	$6 \times 21 = 126$	$9 \times 21 = 189$

Such tables should not be used after the work is understood.

We see that we have first to divide 71 hundreds by 21. From the table we see that the largest product smaller than 71 is $3 \times 21 = 63$, or 8 less than 71. So we know that 71 hundreds $\div$ 21 = 3 hundreds, with remainder 8 hundreds.

```
    341
21)7161
   63
   86
   84
    21
    21
```

We write the 3 in the hundreds' place as the first figure of the quotient.

The remainder, 8 hundreds, equals 80 tens, and 80 tens + 6 tens = 86 tens.

From the table we see that $4 \times 21 = 84$, which is 2 less than 86. So we know that 86 tens $\div$ 21 = 4 tens, with remainder 2 tens, or 20. We therefore write the 4 in the quotient, in the tens' place.

Then 20 + 1 = 21, still to be divided. $21 \div 21 = 1$, and we write the 1 in the quotient, in the ones' place.

The quotient is then 341, and so the manufacturer received $341 for each piano.

To check the answer, $21 \times \$341 = \$7161$.

ORAL EXERCISE

1. Divide each of the following numbers by 31 and state the quotient; if you cannot tell the quotient readily, divide the first figure of the dividend by the first figure of the divisor:

62 93 124 248 186 217

2. Divide each of the following numbers by 41 and state the quotient; dividing the first two figures of the dividend by the first figure of the divisor:

205 123 164 246 287 369

State only the first figure in each quotient:

3. $462 \div 21$.
4. $693 \div 21$.
5. $399 \div 21$.
6. $620 \div 31$.
7. $651 \div 31$.
8. $682 \div 31$.
9. $1230 \div 41$.
10. $1271 \div 41$.
11. $1530 \div 51$.

WRITTEN EXERCISE

Divide the following:

1. $483 \div 21$.
2. $945 \div 21$.
3. $525 \div 21$.
4. $2436 \div 21$.
5. $2793 \div 21$.
6. $496 \div 31$.
7. $943 \div 41$.
8. $589 \div 31$.
9. $1147 \div 31$.
10. $5661 \div 51$.
11. $3024 \div 21$.
12. $1386 \div 21$.
13. $2079 \div 21$.
14. $2601 \div 51$.
15. $1491 \div 71$.

16. At \$21 a dozen, how many rifles can a dealer buy for \$504? for \$693?

17. At \$31 a dozen, how many dozen boys' sweaters can a dealer buy for \$651? for \$961?

Long Division Continued. To divide 3424 by 32 we write the numbers as here shown.

$$\begin{array}{r} 107 \\ 32\overline{)3424} \\ \underline{32} \\ 224 \\ \underline{224} \end{array}$$

We see that 34 hundreds $\div$ 32 = 1 hundred, with remainder 2 hundreds.

We write the 1 in the quotient in the hundreds' place.

Bringing down the next figure, 2 (tens), we have 22 tens to be divided by 32.

But 22 does not contain 32, so we write 0 in the quotient in the tens' place.

Bringing down the next figure, 4, we have 224 to be divided by 32.

224 $\div$ 32 = 7, and we write the 7 in the ones' place.

The quotient is 107.

WRITTEN EXERCISE

Divide the following:

1. 1302 $\div$ 21.	**5.** 6363 $\div$ 21.	**9.** 4824 $\div$ 12.
2. 1224 $\div$ 12.	**6.** 6384 $\div$ 12.	**10.** 2442 $\div$ 22.
3. 3840 $\div$ 32.	**7.** 2142 $\div$ 42.	**11.** 5304 $\div$ 52.
4. 3844 $\div$ 62.	**8.** 3968 $\div$ 62.	**12.** 7344 $\div$ 72.

13. A manufacturer receives \$6882 for a number of canoes, each canoe selling at \$31. How many canoes does he sell?

14. A dealer pays \$2398 for a number of bicycles, each bicycle costing \$22. How many bicycles does he buy?

15. A dealer buys a lot of young Shetland ponies for \$72 apiece. He pays \$7704. How many ponies does he buy?

Long Division Continued. To divide 4503 by 79 we write the numbers as here shown.

$$\begin{array}{r} 57 \\ 79\overline{)4503} \\ \underline{395} \\ 553 \\ \underline{553} \end{array}$$

At first we might think that, because $45 \div 7 = 6$ and a remainder, the first figure of the quotient should be 6. But this would be too large, as we should find, because $6 \times 79 = 474$, which is larger than 450.

We see that 79 is nearly 80, and so we see that we can find the first figure of the quotient more easily by thinking of $45 \div 8$ than by thinking of $45 \div 7$.

In division, no product should be larger than the number above it, and no remainder after any subtraction should be larger than the divisor.

Dividing in the usual way, we find that the quotient obtained by dividing 4503 by 79 is 57.

Check in Division. To divide 5183 by 58 we write the numbers as here shown.

$$\begin{array}{r} 89 \\ 58\overline{)5183} \\ \underline{464} \\ 543 \\ \underline{522} \\ 21 \end{array}$$

Dividing in the usual way, we find that the quotient is 89 and that there is a remainder of 21.

It is customary in such a case to write the result $89\frac{21}{58}$.

To check the work in division

We multiply the quotient by the divisor and to this product add the remainder. This sum should be equal to the dividend.

In this case $89 \times 58 = 5162$, and $5162 + 21 = 5183$.

WRITTEN EXERCISE

Divide the following:

1. $189 \div 21$.
2. $637 \div 91$.
3. $224 \div 32$.
4. $498 \div 83$.
5. $236 \div 59$.
6. $328 \div 41$.
7. $639 \div 71$.
8. $416 \div 52$.
9. $438 \div 73$.
10. $553 \div 79$.
11. $648 \div 81$.
12. $488 \div 61$.
13. $504 \div 72$.
14. $837 \div 93$.
15. $792 \div 99$.

Divide, writing "remainder" after each remainder:

16. $2706 \div 41$.
17. $5368 \div 61$.
18. $6724 \div 82$.
19. $7447 \div 73$.
20. $7614 \div 94$.
21. $6434 \div 59$.
22. $2464 \div 22$.
23. $5475 \div 77$.
24. $3366 \div 51$.
25. $6238 \div 81$.
26. $9568 \div 92$.
27. $3498 \div 53$.

Divide, using fractions instead of remainders:

28. $6809 \div 84$.
29. $7345 \div 65$.
30. $5346 \div 22$.
31. $9639 \div 44$.
32. $6461 \div 71$.
33. $6647 \div 91$.
34. $5084 \div 62$.
35. $9504 \div 72$.
36. $3569 \div 29$.
37. $8148 \div 74$.
38. $3366 \div 66$.
39. $3905 \div 55$.
40. $4872 \div 56$.
41. $2697 \div 93$.
42. $3648 \div 32$.
43. $8512 \div 76$.
44. $8556 \div 23$.
45. $5110 \div 14$.
46. $5248 \div 64$.
47. $3441 \div 37$.
48. $8579 \div 73$.
49. $8957 \div 79$.
50. $7319 \div 53$.
51. $8609 \div 61$.
52. $6891 \div 31$.
53. $3954 \div 23$.
54. $3655 \div 43$.
55. $2576 \div 92$.
56. $9853 \div 49$.
57. $7369 \div 52$.
58. $9423 \div 63$.
59. $6578 \div 74$.
60. $6457 \div 59$.

OPTIONAL PROBLEMS

1. A full game of baseball of 9 innings was played in 135 min. Find the average time of each inning.

2. In a school having 1118 pupils there are 26 classes. Find the average number in each class.

3. A dealer pays \$6375 for some sailboats at \$75 each. How many boats does he buy?

4. A grocer has 576 eggs. He puts them into boxes each holding a dozen eggs. How many boxes did he use?

5. In one week 5754 immigrants landed in New York. Find the average number per day.

Teachers should see that such words as "immigrant" are understood.

6. A clerk has to wrap up 1-cent pieces in packages of 25. If he has \$12.25, how many cents has he, and how many packages will he have?

7. If Matthew's father sells 650 chickens in 26 da., what is the average number sold each day?

8. At a church fair \$52 was taken in the first day, \$45 the second day, and \$108 the third day. Find the average amount per day.

Teachers should state that in a case like that of Ex. 8 the average is found by adding the numbers and dividing by the number of days. Averages do not, in general, "come out even," and at this stage of the work it suffices to give as an answer, "the average is between \$68 and \$69 per day," and similarly for Exs. 9–13.

9. A class of 42 pupils used 75 pads of paper last term, each pad containing 80 sheets. Find the average number of sheets per pupil.

10. At the closing exercises of a school 360 tickets were given out. The highest class received 62 tickets and the rest were divided among 16 classes. What was the average number given to each of these classes?

11. A baseball club sold 350 tickets to the pupils of 15 classes. Find the average number sold to each class.

12. Seven fourth-year classes have the following number of pupils: 43, 48, 45, 39, 38, 41, and 37. Find the average per class.

13. Every morning a teacher wrote the temperature on the blackboard. The temperatures for 5 da. last week were 65°, 66°, 58°, 73°, and 69°. Find the average.

If the pupils do not already know the meaning of 65° and how to read the thermometer, some explanation may be necessary.

14. If each one in a club of 224 members contributes 25¢ to help the poor, and the money is divided equally among 14 families, how much does each family receive?

15. An automobile begins a trip with 29 gal. of gasoline. After traveling 276 mi. there are 6 gal. left. Find the average number of miles traveled per gallon of gasoline.

16. In a certain school building there are 136 windows, each containing 4 panes of glass. If a man cleans 32 panes per hour, how long will it take for all the windows?

17. A baker gains 12¢ on every 5 loaves he bakes. How much will he gain on 10 loaves? on 50 loaves?

18. David can write 1530 words on a typewriter in 30 minutes. What is his average per minute?

VII. MEASURES

ORAL EXERCISE

1. How many inches are there in 1 yd.? in $\frac{1}{2}$ yd.?

2. The wall paper in your house is probably 18 in. wide. This is what part of a yard?

3. The carpet in your house may be 27 in. wide. This is what part of a yard?

4. If you buy some cloth that is $\frac{3}{4}$ yd. wide, what is its width in inches?

Length. The following is the table of length:

12 inches (in.) = 1 foot (ft.)
3 feet or 36 inches = 1 yard (yd.)
5280 feet = 1 mile (mi.)

The teacher should assist the pupils to visualize these basal units. The number of blocks to the mile, the number of feet in the width of the streets, and the average size of building lots should be explained to the pupils. The rod ($16\frac{1}{2}$ ft.) may be mentioned incidentally, although it is not used in cities.

WRITTEN EXERCISE

1. How many feet in 17 yd.? in 36 yd.? in $5\frac{1}{2}$ yd.?
2. How many feet in $\frac{1}{2}$ mi.? in $\frac{1}{4}$ mi.? in $\frac{1}{8}$ mi.?
3. How many yards in $\frac{1}{2}$ mi.? in $\frac{1}{4}$ mi.? in $\frac{1}{8}$ mi.?
4. How many inches in 1 yd.? in $2\frac{1}{2}$ yd.? in 1 mi.?
5. How many feet in 1760 yd.? in 5280 yd.?
6. How many yards in 792 ft.? in 1065 ft.?

ORAL EXERCISE

1. Meat is sold by the pound. Candy is sold by the pound. Pepper is sold by the ounce. Do you know how coal is sold? Do you know how hay is sold?

2. Can you name anything else that is sold by the ounce? by the pound? by the ton?

3. How many ounces are there in a pound? How many pounds in a ton?

Weight. The following is the table of weight:

16 ounces (oz.) = 1 pound (lb.)

2000 pounds = 1 ton (T.)

The ton is used in weighing substances sold in heavy loads, like coal, hay, building stone, and iron.

WRITTEN EXERCISE

1. At \$6.75 a ton, how much will 17 T. of coal cost?

2. At \$5.50 a ton, how much will 34 T. of coal cost?

3. At \$96 for 16 T., how much will 1 T. of coal cost?

4. At \$7.25 a ton, how much will 9 T. of coal cost?

5. When coal is worth \$6.25 a ton, how much will 7 T. cost? 14 T.? 19 T.? 28 T.? 37 T.? 49 T.?

6. How much will 17 T. of coal cost at \$4.75 a ton?

7. How much is the cost of 26 T. of coal at \$4.95 a ton? at \$5.30 a ton? at \$5.80 a ton? at \$6.25 a ton?

8. How much does coal cost a ton when 9 T. cost \$54?

9. How much is coal worth when 24 T. cost \$168?

ORAL EXERCISE

1. About how much does milk cost a quart where you live? How much is this a pint?

2. How many pints are there in a quart? A pint is what part of a quart?

3. How many quarts are there in a gallon? A quart is what part of a gallon?

4. Name something that is sold by the pint; something sold by the quart; something sold by the gallon.

Liquid Measure. The following is the table of liquid measure:

2 pints (pt.) = 1 quart (qt.)

4 quarts = 1 gallon (gal.)

Like the tables of length and weight, the tables of liquid and dry measure are more or less familiar to the pupils, being required in the earlier grades. They must necessarily be reviewed from time to time, and are used in the practical problems in every grade. The actual measures should be used in this grade as in the preceding grades.

WRITTEN EXERCISE

Find the number of pints in:

1. 7 qt. **2.** 13 qt. **3.** 7 gal. **4.** 32 gal. **5.** 48 gal.

Find the number of quarts in:

6. 32 pt. **7.** 48 pt. **8.** 9 gal. **9.** 56 gal. **10.** 128 gal.

Find the number of gallons in:

11. 64 pt. **12.** 72 pt. **13.** 56 qt. **14.** 72 qt. **15.** 128 qt.

ORAL EXERCISE

1. Name something that the grocer sells by the bushel; something that he sells by the peck.

2. Name some kind of fruit that is sold by the quart.

3. How many quarts are there in a peck? How many pecks are there in a bushel?

Dry Measure. The following is the table of dry measure:

2 pints (pt.) = 1 quart (qt.)
8 quarts = 1 peck (pk.)
4 pecks = 1 bushel (bu.)

WRITTEN EXERCISE

1. If a pushcart man buys 3 bu. of apples and sells them by the peck, how many pecks can he sell?

2. If a pushcart man pays \$1 for 1 bu. of apples and sells them for 40¢ a peck, how much does he gain on each peck? How much does he gain on the bushel?

Find the number of quarts in:

3. 12 pk. 4. 14 pk. 5. 24 pk. 6. 38 pk. 7. 56 pk.

Find the number of pecks in:

8. 64 qt. 9. 64 bu. 10. 37 bu. 11. 29 bu. 12. 56 bu.

13. How many quarts of plums are there in 1 bu.?

14. How many quarts of nuts are there in 16 bu.?

15. How many bushels of potatoes are there in 48 pk.?

ORAL EXERCISE

1. Estimate the length and the width of this room.
2. How high is the chalk rack from the floor?
3. How high do you think the door is?
4. How wide do you think the street is in front of the schoolhouse? in front of your house?
5. How many inches do you step in taking a long step?
6. Tell some place that is about 1 mi. from the schoolhouse; some place that is about $\frac{1}{4}$ mi. from the schoolhouse.

Teachers should make sure that the pupils have a definite idea of the value of each item in the various tables, and should fix these ideas of values by frequent reviews and drills in which the words are used concretely. They should use the blackboard, the schoolroom floor, and the school yard to illustrate distances. The pupils should learn to pace feet and yards. The distance from the school to some well-known point should be fixed as a standard mile to which the pupils can refer in making estimates. Much practice in estimating should be given, and the estimates should be followed by actual measurements whenever possible.

WRITTEN EXERCISE

1. Find the number of ounces in 14 lb.; in 18 lb.
2. Find the number of pounds in 98 oz.; in 114 oz.
3. Find the number of quarts in 17 gal.; in 29 gal.
4. Find the number of gallons in 17 qt.; in 29 qt.
5. Find the number of pecks in 28 bu.; in 35 bu.
6. Find the number of bushels in 28 pk.; in 35 pk.
7. A book weighing $2\frac{1}{4}$ lb. weighs how many ounces?
8. If a street is 66 ft. wide, what is its width in yards?

OPTIONAL PROBLEMS

1. Edith and her mother are making jelly. How many half-pint jars do they need to hold $4\frac{1}{2}$ gal. of jelly?

2. Edith finds that cinnamon costs 6¢ an ounce, but that she can buy it at 45¢ a pound. If she and her mother need a pound of cinnamon, how much do they save if they buy 1 lb. by the pound instead of by the ounce?

3. Mrs. Asch pays 8¢ a quart for milk. If she buys 24 pint-bottles and 31 quart-bottles of milk in a month, how much is her bill?

4. A baker makes 64 cakes, each containing 4 oz. of flour. How many pounds of flour does he use?

5. The school playground is 50 yd. long. Allowing 2 ft. of space to each boy, how many boys can stand in a line extending the length of the playground?

6. Tony's father keeps a fruit stand. He sells 3 bu. of apples at 7¢ a quart. How much does he receive?

7. Mr. Brown spends 10¢ every Sunday for his newspapers and 3¢ every week day. How much does he spend for newspapers in 1 wk.? in 52 wk.?

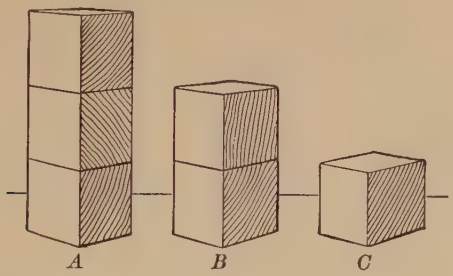
8. John can walk the length of the schoolroom in 16 steps. If each of his steps measures 21 in., find the number of inches in the length of the room. Find also the number of feet.

9. A cup of flour weighs 8 oz. If a wedding cake requires 18 cups of flour, how many ounces of flour are needed? How many pounds are needed?

VIII. FRACTIONS

ORAL EXERCISE

1. Block B is how many times as large as C? Then C is equal to what part of B?



2. Block A is how many times as large as C? Then C is equal to what part of A?

3. If C weighs 1 lb., how much does B weigh? If B weighs 1 lb., how much does C weigh?

4. If C weighs 1 lb., how many pounds do A and B together weigh?

5. If B weighs 1 lb., how many pounds do A and C together weigh?

6. If C is 1 ft. high, how many feet high is A?

7. If B is 1 ft. high, how high is C?

WRITTEN EXERCISE

Copy and complete:

1. $\frac{1}{3}+\frac{1}{3}=(\quad)$.

2. $\frac{1}{3}+\frac{1}{3}+\frac{1}{3}=(\quad)$.

3. $\frac{1}{3}-\frac{1}{3}=(\quad)$.

4. $1-\frac{1}{2}=(\quad)$.

5. $\frac{1}{3}$ of $6=(\quad)$.

6. $\frac{1}{3}$ of $9=(\quad)$.

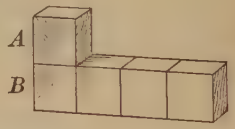
ORAL EXERCISE

1. If this block is 4 in. high and $\frac{1}{2}$ as thick, how many inches thick is it?

2. If it weighs 3 lb., how many pounds would it weigh if it were only $\frac{1}{3}$ as high?

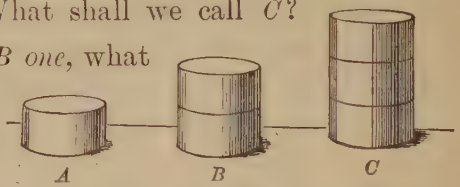
3. If it weighs 3 lb., how many pounds would it weigh if it were twice as high?

4. The ends of each of these blocks are 1 in. square; A is 1 in. long and B is 4 in. long. If we call A *one*, what shall we call B? If we call B *one*, what shall we call A? If we call A *two*, what shall we call B?



5. If we call the round block A *one*, what shall we call round block B? What shall we call C?

6. If we call block B *one*, what shall we call block A? What shall we call C?



7. If we call block B *two*, what shall we call A? What shall we call C?

8. If we call block C *one*, what shall we call B? We write $\frac{2}{3}$ for two thirds.

9. If B weighs 1 lb., how much does A weigh?

10. If C weighs 1 lb., how much does B weigh?

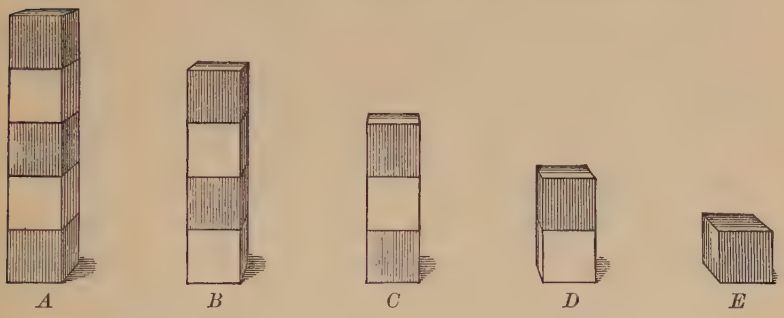
11. If B is 2 in. high, how many inches high is A?

12. If B is 2 in. high, how many inches high is C?

13. If B is 4 in. high, how many inches high is A?

ORAL EXERCISE

1. Which block is 5 times as large as E?
2. Point to the block which is $\frac{1}{5}$ as large as A.



3. Point to the block which is $\frac{2}{5}$ as large as A.

Point to the blocks which are:

4. $\frac{3}{5}$ as large as A.
5. $\frac{4}{5}$ as large as A.
6. $\frac{2}{3}$ as large as C.
7. $\frac{3}{4}$ as large as B.
8. If we call A *one*, what shall we call E? D? C? B?
9. If we call B *one*, what shall we call E? D? C?
10. Using blocks B, C, D, and E, show that $\frac{1}{4}+\frac{1}{4}=\frac{1}{2}$, and that $\frac{1}{2}+\frac{1}{4}=\frac{3}{4}$.

WRITTEN EXERCISE

1. Draw lines 10 in. long and 2 in. long. The 2-inch line is what part as long as the 10-inch line?
2. Draw a line $\frac{2}{5}$ as long as the 10-inch line.
3. Draw a line $\frac{4}{5}$ as long as the 10-inch line. It is how many inches long?

ORAL EXERCISE

1. How do you find $\frac{1}{2}$ of a number?

2. To find $\frac{3}{4}$ of a number you first divide by what number? You then multiply by what number?

3. Find $\frac{3}{4}$ of 8; of 12; of 16; of 20; of 40; of 48.

4. How do you find $\frac{2}{3}$ of a number?

5. Find $\frac{2}{3}$ of 9; of 12; of 15; of 21; of 33; of 36.

6. How do you find $\frac{4}{5}$ of a number?

7. Find $\frac{4}{5}$ of 10; of 15; of 25; of 35; of 500.

8. How do you find $\frac{5}{6}$ of a number?

9. Find $\frac{5}{6}$ of 12; of 18; of 24; of 36; of 300.

Find $\frac{5}{6}$ of each of the following numbers:

10. 66. 12. 42. 14. 60. 16. 600. 18. 666.
11. 30. 13. 48. 15. 72. 17. 660. 19. 1200.

WRITTEN EXERCISE

1. A man had \$7500 in the bank and later took out half of it. How much does he take out?

2. There are 376 pupils in a certain school, and three quarters of them are in the first five grades. How many are in the first five grades?

3. A grocer bought a box of 198 oranges and sold $\frac{2}{3}$ of them the first day. How many oranges did he sell?

Find $\frac{4}{5}$ of each of the following numbers:

4. 725. 5. 865. 6. 770. 7. 890.

ORAL EXERCISE

1. In a class of 32 pupils $\frac{5}{8}$ are girls. How shall we find the number of girls? How many girls are there?

2. How do you find $\frac{1}{8}$ of a number? $\frac{3}{8}$ of a number?

Find $\frac{1}{8}$ of each of the following numbers:

3. 24. **4.** 32. **5.** 48. **6.** 72. **7.** 96.

Find $\frac{3}{8}$ of each of the following numbers:

8. 16. **9.** 24. **10.** 32. **11.** 80. **12.** 88.

Find $\frac{5}{8}$ of each of the following numbers:

13. 8. **14.** 16. **15.** 40. **16.** 56. **17.** 64.

Find $\frac{7}{8}$ of each of the following numbers:

18. 16. **19.** 24. **20.** 40. **21.** 48. **22.** 88.

WRITTEN EXERCISE

1. A grocer has a box containing 192 oranges. If he sells $\frac{3}{8}$ of them, how many oranges does he sell?

Find $\frac{3}{8}$ of each of the following numbers:

2. 176. **3.** 264. **4.** 352. **5.** 576.

Find $\frac{5}{8}$ of each of the following numbers:

6. 184. **7.** 272. **8.** 368. **9.** 592.

Find $\frac{7}{8}$ of each of the following numbers:

10. 496. **11.** 504. **12.** 568. **13.** 848.

ORAL EXERCISE

Find the value of each of the following:

1. $\frac{1}{2}$ of 4.	7. $\frac{1}{2}$ of 40.	13. $\frac{1}{8}$ of 16.	19. $\frac{1}{3}$ of 45.
2. $\frac{1}{2}$ of 6.	8. $\frac{1}{2}$ of 50.	14. $\frac{1}{8}$ of 56.	20. $\frac{2}{3}$ of 45.
3. $\frac{1}{2}$ of 10.	9. $\frac{1}{4}$ of 20.	15. $\frac{1}{8}$ of 40.	21. $\frac{1}{5}$ of 20.
4. $\frac{1}{2}$ of 16.	10. $\frac{1}{4}$ of 24.	16. $\frac{3}{8}$ of 40.	22. $\frac{2}{5}$ of 20.
5. $\frac{1}{2}$ of 24.	11. $\frac{1}{4}$ of 32.	17. $\frac{1}{3}$ of 24.	23. $\frac{3}{5}$ of 20.
6. $\frac{1}{2}$ of 30.	12. $\frac{3}{4}$ of 32.	18. $\frac{2}{3}$ of 24.	24. $\frac{4}{5}$ of 20.

25. In a certain class there are 42 pupils and half of them are girls. How many girls are there?

WRITTEN EXERCISE

Find the value of each of the following:

1. $\frac{1}{3}$ of 39.	6. $\frac{3}{4}$ of 28.	11. $\frac{3}{8}$ of 64.	16. $\frac{4}{5}$ of 40.
2. $\frac{2}{3}$ of 39.	7. $\frac{3}{4}$ of 72.	12. $\frac{3}{8}$ of 72.	17. $\frac{1}{6}$ of 24.
3. $\frac{2}{3}$ of 75.	8. $\frac{3}{4}$ of 60.	13. $\frac{1}{5}$ of 15.	18. $\frac{5}{6}$ of 72.
4. $\frac{2}{3}$ of 78.	9. $\frac{1}{8}$ of 64.	14. $\frac{2}{5}$ of 15.	19. $\frac{1}{7}$ of 14.
5. $\frac{1}{4}$ of 28.	10. $\frac{3}{8}$ of 48.	15. $\frac{3}{5}$ of 15.	20. $\frac{2}{7}$ of 14.

21. It is 16 mi. to a certain place, and $\frac{3}{4}$ as far to another place. How far is it to the second place?

22. If a boy is 48 in. tall, and his sister is $\frac{7}{8}$ as tall, how tall is she?

23. If a lot is 96 ft. deep and $\frac{5}{8}$ as wide, how wide is it?

24. At 48¢ a yard, how much will $\frac{5}{8}$ yd. of cloth cost?

25. At 24¢ a pound, how much will $\frac{3}{4}$ lb. of figs cost?

OPTIONAL PROBLEMS

1. If you spend $\frac{1}{3}$ of your time in sleep, how many hours do you sleep in a week?

2. If a clerk who receives \$72 a month saves $\frac{1}{8}$ of his wages, how much does he save in a year?

3. Going by trolley it takes Peter 45 min. to reach his cousin's house, but by train it takes him only $\frac{2}{5}$ as long. How long does it take him by train?

4. Helen was told to go to the blackboard and mark off $\frac{1}{6}$ of the length. The blackboard was 20 ft. long, and she marked off 30 inches. Was this too much or too little? How many inches should she mark off?

5. About $\frac{3}{4}$ of the weight of a calf can be sold by the butcher for veal. How many pounds of veal can he get from a number of calves weighing 620 lb. in all?

6. Henry's father keeps a shoe store. The shoes that he sold last Monday cost him \$72, and his profit was $\frac{1}{4}$ of the cost. Find his profit and the amount which he received for the shoes.

7. Henry's father finds that $\frac{2}{3}$ of his profit is used for rent and other expenses. If his profit on the sale of shoes was \$468 last month, how much of this did he use for expenses? How much did he have left?

It is well to mention incidentally that the amount he had left was his *net profit*. The term is formally presented later in the work.

8. At 24¢ a pound, how much will $\frac{1}{2}$ lb. of figs cost? How much will $1\frac{1}{2}$ lb. cost?

9. A grocer paid 18¢ a pound for 75 lb. of coffee and sold it so as to gain $\frac{2}{5}$ as much as the coffee cost him. How much did he gain?

10. The rent of the flat in which Jacob lives is $324 a year. Two lodgers pay $\frac{1}{3}$ of the rent, and Jacob's father pays the rest. How much does Jacob's father pay?

11. Julia uses 8 cupfuls in measuring out 4 lb. of flour. How many ounces of flour does the cup hold?

12. William's brother can walk to the high school in 48 min. and can ride the distance in $\frac{1}{2}$ of this time. If he leaves home at 8.30 A.M. and rides to the high school, at what time should he reach there?

13. John's father is in business in his office from 8 A.M. to 5 P.M. with an hour off for luncheon. How many hours is he in his office in 26 da.?

14. If you are in school $\frac{1}{4}$ of the time on Monday, how many hours are you in school on that day, and how many hours are you not in school?

15. Lena's mother finds that she can buy oranges at 5¢ each or 48¢ a dozen. If she needs 24 oranges, how much does she save if she buys them by the dozen instead of by the orange? If she needs $\frac{1}{2}$ doz. oranges, how much does she save if she buys them at the dozen rate?

16. If Mr. Kane weighs 160 lb. and his son weighs $\frac{1}{4}$ as much, how much does the son weigh? How much do the father and son together weigh?

17. At $36 a dozen, how much must a dealer pay for $\frac{1}{4}$ doz. hats? How much must he pay for $1\frac{1}{2}$ doz.?

IX. USING WHAT YOU HAVE LEARNED

A BIRTHDAY PARTY

1. Frances is having a birthday party. She bought 9 small candles at 2¢ each and one larger candle for 4¢. How much did she pay for all of the candles?

2. If Frances gave the storekeeper 50¢ for the candles, how much change did she get back?

3. Four of her friends came. If she provided four pieces of cake for each one who came and four for herself, how many pieces of cake did she provide?

4. She made a cake, using 3 eggs worth 36¢ a dozen, 3¢ worth of sugar, 2¢ worth of flour, and 2¢ worth of other materials. How much did all the materials cost?

OPTIONAL PROBLEMS

1. Sarah has saved 84¢ and Mary \$1.45 with which to buy presents for their parents. They buy their father a pair of slippers for 98¢. How much is left for a present for their mother?

2. Tony's mother earns \$2.25 a week by sewing. His father gives her \$6.50 a week out of his wages, and his sister gives her \$3.75 a week out of what she earns. Tony's mother pays \$3.50 a week for rent and \$8 for other expenses. How much can she save in a week?

3. A man owns a house with 4 apartments. He charges \$336 rent a year for each apartment. If 3 apartments are rented all the year and the fourth for 6 mo., how much rent does the owner receive?

4. A school uses 6447 paper pads in 21 wk. Find the average number used per week.

5. A barber charges 15¢ for a shave and 25¢ for a hair cut, and on Monday he shaved 18 men and cut the hair of 9 men. How much money did he take in?

6. At an athletic meet the boys paid \$58.50 for rent and other expenses. They collected \$14.85 for advertisements on their programs and \$52.75 from the sale of tickets. How much money did they put in their treasury?

7. A grocer bought 1188 oranges. If he sold them at 45¢ a dozen, how much money did he receive?

8. A garage keeper sold an average of 6 qt. of automobile oil a day for 30 da. How many gallons did he sell?

9. If milk costs 10¢ a quart and cream costs 40¢ a quart, how much will a family have to pay for 2 qt. 1 pt. of milk and 1 pt. of cream every day for 31 da.?

10. A truck driver has to feed 8 horses a day. If he gives 12 qt. of oats to each horse daily, how many quarts will he need for all the horses in the month of September? How many bushels will he need?

11. If a trolley car makes 6 round trips a day, carrying an average of 96 passengers on each round trip, how many passengers does it carry in a day? If $\frac{1}{4}$ of these passengers ride on transfers, how many pay cash fares?

12. In a certain year of 365 da. there were 105 Saturdays and Sundays. Of the other days, $\frac{1}{4}$ were vacations and holidays. How many school days were there?

13. The driver of an ice wagon starts out with a ton of ice. He loses 80 lb. by melting and cutting and sells $\frac{5}{6}$ of the rest. How much does he bring back?

14. Mr. Hall rents a flat for $456 a year, and lets his friend Mr. White have a room for $\frac{1}{6}$ of the rent. How much rent does each pay?

15. A flower garden 24 ft. long is divided into 4 equal lengths. In one of the spaces a pansy is planted for every 4 in. of length. How many pansies are planted?

16. An expressman delivers 36 trunks on an average every day during January, including Sundays. If he charges 25¢ for each trunk, how much will he receive in the month? If $\frac{3}{4}$ of what he receives is paid out for expenses, how much does he have for himself?

LITTLE EXAMINATIONS

I. 1. $578 + 296$. 5. 28×324. 9. $2575 \div 25$.
2. $\$2.75 + \$3.69$. 6. 50×672. 10. $\frac{1}{4}$ mi. = (?) ft.
3. $342 - 196$. 7. $7344 \div 36$. 11. $2\frac{1}{2}$ lb. = (?) oz.
4. 24×86. 8. XC = (?). 12. $\frac{1}{3}$ of 729.

II. 1. $983 + 432$. 5. 86×981. 9. $2775 \div 75$.
2. $\$4.87 + \$3.73$. 6. 87×392. 10. 963 ft. = (?) yd.
3. $481 - 296$. 7. $5304 \div 26$. 11. 48 oz. = (?) lb.
4. 48×94. 8. LXXI = (?). 12. $\frac{1}{3} + \frac{1}{3} + \frac{1}{3}$.

III. 1. $887 + 556$. 6. 50×667. 11. $4\frac{1}{2}$ lb. = (?) oz.
2. $\$2.88 + \$1.97$. 7. $3968 \div 31$. 12. $\frac{1}{4} + \frac{1}{4}$.
3. $513 - 234$. 8. XLI = (?). 13. $8536 \div 97$.
4. 33×69. 9. $6084 \div 54$. 14. 50 bu. = (?) pk.
5. 53×787. 10. 888 ft. = (?) yd. 15. 4 lb. = (?) oz.

IV. 1. $826 + 697$. 6. 56×109. 11. 23 lb. = (?) oz.
2. $\$5.38 + \$1.96$. 7. $2250 \div 25$. 12. $\frac{7}{8}$ of 176.
3. $723 - 547$. 8. 156 in. = (?) ft. 13. $6336 \div 48$.
4. 67×96. 9. LXX = (?). 14. XCI = (?).
5. 48×137. 10. 507 ft. = (?) yd. 15. 64 oz. = (?) lb.

These may be used in the last few weeks of the work of the half year. These examinations are designed to keep the pupils constantly in touch with the more important topics studied during the half year, and especially with the fundamental operations.

GRADE IV. SECOND HALF

I. REVIEW

ORAL EXERCISE

Add the following:

1.	2.	3.	4.	5.	6.
26	26	42	45	67	67
31	35	28	28	13	19

Subtract the following:

7.	8.	9.	10.	11.	12.
67	67	59	51	96	96
22	28	13	13	54	57

WRITTEN EXERCISE

Add the following:

1.	2.	3.	4.	5.
407	775	8348	4876	18,123
628	882	5109	5983	20,176
342	609	6973	2809	10,987

Subtract the following:

6.	7.	8.	9.	10.
900	812	5213	9001	53,713
286	397	1987	6287	39,865

ORAL EXERCISE

Multiply the following:

1.	2.	3.	4.	5.	6.
50	51	60	600	601	701
4	4	8	8	8	9

Divide the following:

7.	8.	9.	10.	11.
2)84	2)840	3)36	3)360	3)3600

WRITTEN EXERCISE

Multiply as indicated:

1. 27×486.
2. 39×548.
3. 64×827.
4. 124×236.
5. 148×327.
6. 267×319.
7. 209×367.
8. 218×419.
9. 302×316.

Divide as indicated:

10. $9324 \div 84$.
11. $7072 \div 68$.
12. $9945 \div 45$.
13. $9984 \div 32$.
14. $7788 \div 59$.
15. $8778 \div 57$.
16. $4531 \div 28$.
17. $2909 \div 35$.
18. $6783 \div 71$.

Find the following:

19. $\frac{3}{4}$ of 256 men.
20. $\frac{4}{5}$ of 485 boys.
21. $\frac{3}{8}$ of 864 girls.
22. $\frac{5}{6}$ of 636 ft.
23. $\frac{5}{8}$ of 736 ft.
24. $\frac{7}{8}$ of 968 ft.
25. $\frac{3}{5}$ of \$905.
26. $\frac{7}{8}$ of \$744.
27. $\frac{3}{5}$ of \$275.

28. Find the number of quarts in 96 gal., the number of inches in 96 ft., and the number of ounces in 96 lb.

II. READING AND WRITING NUMBERS TO 1,000,000

ORAL EXERCISE

1. Count by 1000's from 1000 to 10,000.
2. Count by 10,000's from 10,000 to 90,000.
3. Count by 100,000's from 100,000 to 900,000.

Reading Numbers. In the number 23,546 a comma is written between the thousands and the hundreds, and

the 6 occupies the ones' place,
the 4 occupies the tens' place,
the 5 occupies the hundreds' place,
the 3 occupies the thousands' place,
the 2 occupies the ten-thousands' place.

There is a special name for a thousand thousand. This number is called a *million*, and is written 1,000,000.

Read the following:

4. 40,000. 6. 41,525. 8. 100,000. 10. 468,921.
5. 50,050. 7. 50,005. 9. 900,000. 11. 999,999.

WRITTEN EXERCISE

Write in words:

1. 125,050. 2. 500,005. 3. 1,000,000.

Write in figures:

4. Seventy thousand. 5. Nine hundred thousand.

Roman Notation. The Roman notation, used chiefly for numbering the chapters of books, employs seven letters, as follows:

Letters,	I	V	X	L	C	D	M
Values,	1	5	10	50	100	500	1000

The first nine numbers are written thus:

I II III IV or IIII V VI VII VIII IX

The tens are written thus:

X XX XXX XL L LX LXX LXXX XC

The hundreds are written thus:

C CC CCC CD D DC DCC DCCC DCCCC or CM

The numbers from eleven to nineteen are written thus;

XI XII XIII XIV XV XVI XVII XVIII XIX

The following are examples of other numbers:

XXIII = 23 XCVIII = 98 CLXVI = 166
XXXVI = 36 LXXVI = 76 CCCLIX = 359
MDCCCCXVII or MCMXVII = 1917

WRITTEN EXERCISE

Write in common figures:

1. XI. 3. XXVI. 5. LXXII. 7. LXXVII.
2. LXIV. 4. LXVI. 6. XCVII. 8. XXXIV.

Write in Roman numerals:

9. 31. 11. 42. 13. 67. 15. 175. 17. 1919.
10. 89. 12. 91. 14. 75. 16. 150. 18. 1920.

III. ADDITION

WRITTEN EXERCISE

1. George works after school for Mr. Forbes. Mr. Forbes set him at work sorting oranges. George found 196 good oranges in one box and 188 in another box. How many good oranges did he find in both boxes?

2. Mr. Forbes had him take the cans of fruit from the shelves so as to count them. George counted 97 cans of peaches, 86 cans of pears, and 47 cans of plums. How many cans were there of all three kinds?

3. George arranged some cakes of soap on the shelves. There were 127 cakes of one kind, 246 of another, and 144 of another. How many cakes of soap were there?

4. George polished the eating apples so that they would sell better. He polished 98 apples of one kind and 139 of another. How many apples did he polish?

5. Mr. Forbes paid George 15¢ on Monday, 15¢ on Tuesday, 18¢ on Wednesday, 20¢ on Thursday, 15¢ on Friday, and 25¢ on Saturday. How many cents did he pay him that week?

6. Mr. Forbes put $25 in the bank on Monday, $35 on Tuesday, $30 on Wednesday, $36 on Thursday, $45 on Friday, and $48 on Saturday. How much money did he put in the bank that week?

7. If Mr. Forbes had $250 in the bank, and then put in $75 more, and later drew out $25, how much money did he have left in the bank?

ORAL EXERCISE

1. Count by 2's from 2 to 20, and from 1 to 21.

2. Count by 3's from 3 to 30, from 1 to 31, and from 2 to 32.

3. Count by 4's from 4 to 40, from 1 to 41, from 2 to 42, and from 3 to 43.

This is what is meant by counting by 4's, beginning with any digit. Counting should extend to 10 times the number counted.

Beginning with any digit, count by the following:

4. 5's. **5.** 6's. **6.** 7's. **7.** 8's. **8.** 9's.

Such counting, familiar from the preceding work of Grades III and IV, should be reviewed from time to time. Rapid counting has in it the game element and is valuable in fixing auditory images of great value in addition, subtraction, and multiplication.

Add the following:

9.	10.	11.	12.	13.	14.
41	43	52	55	72	77
28	28	36	36	27	27
15.	**16.**	**17.**	**18.**	**19.**	**20.**
36	36	61	65	83	83
42	47	29	29	11	17
21.	**22.**	**23.**	**24.**	**25.**	**26.**
92	92	92	88	88	88
10	15	19	11	12	17

In adding 45 and 28 it is easier to add the tens first. In this case think of 65 (that is, $45+20$) and 8, stating only the result, 73.

WRITTEN EXERCISE

Add, timing yourself:

1.	2.	3.	4.	5.
$217	246	276	329	$437
343	434	427	286	293

6.	7.	8.	9.	10.
$127	142	326	463	$123
246	237	293	298	247
329	421	147	127	409

11.	12.	13.	14.	15.
106	213	106	132	222
287	129	219	167	333
109	308	137	207	111

16.	17.	18.	19.	20.
121	106	217	272	319
42	92	102	129	107
37	37	69	106	28
168	15	72	43	63

21.	22.	23.	24.	25.
$136	$127	$147	$192	$400
42	38	29	37	125
81	25	108	91	30
92	172	32	82	19
237	81	129	263	16
148	69	70	109	128

ORAL EXERCISE

1. This morning Edith made purchases amounting to \$2.50 at the grocer's and \$1.10 at the butcher's. How much did she spend in all?

2. There are 75 boy scouts in one company and 60 in another. How many are there in both companies?

Add the following:

3.	4.	5.	6.	7.
\$2.20	\$1.60	\$1.60	\$1.70	\$3.80
3.10	1.30	1.40	1.40	5.10

WRITTEN EXERCISE

Add the following:

1.	2.	3.	4.	5.
1728	3686	52,820	\$175.20	\$273.48
2346	2597	41,674	263.36	196.52
5470	6283	37,486	471.52	37.93
6283	4176	26,567	826.00	100.75
4179	5289	30,002	39.75	623.07

6.	7.	8.	9.	10.
4236	4386	34,262	\$276.74	\$821.09
3487	9284	41,728	821.96	632.73
5256	3977	86,089	379.87	421.56
9823	8285	65,738	546.55	178.91
3421	5657	58,272	728.37	367.27
6287	4009	13,911	627.48	578.44

OPTIONAL PROBLEMS

1. Find the amount of the following bill of groceries: 1 can of cocoa, 18¢; 1 qt. of maple sirup, 55¢; 1 package of self-raising flour, 36¢; 1 doz. eggs, 36¢; 3 grapefruits, 25¢; 1 can of corn, 13¢; 1 can of peas, 12¢; 1 jar of marmalade, 25¢.

2. John and Henry live on the school street. John lives 1056 ft. west of the school, and Henry lives 792 ft. east of the school. How far is it from John's home to Henry's home?

3. A milkman delivered 126 quart-bottles and 52 pint-bottles of milk, and had 6 quart-bottles and 8 pint-bottles left in the wagon. How many quart-bottles and how many pint-bottles did he have when he started out?

4. In a professional game of baseball the time required for the nine innings was 9 min., 12 min., 15 min., 8 min., 10 min., 15 min., 14 min., 11 min., and 9 min. Harry went into the grounds 15 min. before the game began and left 4 min. after the game ended. How long was he in the grounds?

5. A mother gave her married daughter a china set consisting of the following pieces: 1 doz. cups and saucers costing $3.38; 1 doz. small plates, $1.69; 1 doz. dinner plates, $3.69; 1 doz. soup plates, $3.04; 1 sauce dish, $1.45; 1 sugar bowl, 44¢; 1 cake plate, 44¢; 1 meat platter, $1.28; 1 small platter, 84¢; 1 spoon holder, 26¢; 1 vegetable dish, 66¢; 1 butter dish, 85¢. Find the total cost.

WRITTEN DRILL

Add the numbers in column I, in column II, and also in column III that stand opposite the following letters:

1. *ab.*	14. *opq.*	27. *stuv.*
2. *bc.*	15. *rst.*	28. *ampt.*
3. *cd.*	16. *abc.*	29. *aegv.*
4. *de.*	17. *def.*	30. *blqt.*
5. *ef.*	18. *ghi.*	31. *acem.*
6. *fg.*	19. *jkl.*	32. *bdhn.*
7. *gh.*	20. *mno.*	33. *dgmn.*
8. *hi.*	21. *pqr.*	34. *aikp.*
9. *ij.*	22. *stu.*	35. *ampv.*
10. *jk.*	23. *luv.*	36. *oqtu.*
11. *kl.*	24. *adf.*	37. *abcd.*
12. *lm.*	25. *kmp.*	38. *cdef.*
13. *mn.*	26. *qrv.*	39. *dfhj.*

For example, take the case of Ex. 24 in column I. Here we have $1472 + 6305 + 2269 = 10{,}046$. The corresponding example in column II is $2989 + 2097 + 1347 = 6433$.

Teachers are urged to undertake this drill work *in the spirit of a game, using only as many examples as are really needed.* After that the work ceases to have any value.

	I	II	III
a	1472	2989	$20.09
b	3819	3763	$36.43
c	4007	4298	$29.92
d	6305	2097	$47.77
e	4178	5662	$82.81
f	2269	1347	$12.80
g	3483	4909	$34.68
h	2047	6177	$92.89
i	5276	8293	$57.93
j	7341	5781	$82.41
k	8297	2896	$44.40
l	4809	4323	$27.86
m	6776	8298	$45.85
n	8112	4197	$56.70
o	3009	3348	$29.87
p	4765	6277	$43.82
q	2993	8192	$61.91
r	9768	3841	$41.28
s	4747	4020	$34.07
t	8707	8002	$62.42
u	9655	5807	$84.45
v	4322	6293	$21.01

IV. SUBTRACTION

ORAL EXERCISE

1. If you have 75¢ and spend 25¢, how much money have you left?

2. If 48 pupils go to a picnic, and 25 are girls and the rest are boys, how many are boys?

Subtract rapidly:

3.	4.	5.	6.	7.	8.
82	82	76	76	93	93
20	23	40	48	23	25

In subtracting 28 from 75 it is easier to subtract the tens first. Thus we think of 55 (that is, 75 – 20) – 8, or 47.

WRITTEN EXERCISE

Subtract, timing yourself and checking the work:

1.	2.	3.	4.	5.	6.
236	342	409	527	400	326
129	273	263	329	192	178

7.	8.	9.	10.	11.	12.
409	600	725	908	752	360
237	482	536	809	429	290

13.	14.	15.	16.	17.	18.
728	342	801	712	801	902
299	139	236	348	296	327

WRITTEN REVIEW

Add the following:

1. $487 + 1263 + 1079$.
2. $102 + 2347 + 3687$.
3. $209 + 1874 + 2096$.
4. $142 + 1346 + 4892$.
5. $324 + 3821 + 1924$.
6. $728 + 2693 + 1982$.
7. $298 + 1789 + 2864$.
8. $427 + 1089 + 1987$.
9. $327 + 2483 + 1872$.
10. $278 + 2873 + 1296$.

11. There are 5280 ft. in a mile, and 2640 ft. in a half mile; how many feet in a mile and a half?

12. A man started in business with \$5500. He saved \$750 the first year and \$875 the second. How much money did he have in all at the end of the second year?

Make problems in addition for Exs. 13–17, and add:

13.	14.	15.	16.	17.
5280 ft.	\$2575	\$1575	\$4500	\$50.00
2640	575	1275	625	27.60
1320	1425	2010	795	41.45

Add or subtract as indicated:

18. $6723 - 594$.
19. $\$650 + \$75$.
20. $\$8.26 - \$7.85$.
21. $4826 - 2938$.
22. $2987 + 1799$.
23. $3702 - 2075$.
24. $4805 + 2967$.
25. $5120 - 1635$.
26. $6000 - 1750$.
27. $7001 - 1992$.
28. $6201 - 2732$.
29. $\$4229 + \$869$.
30. $\$43.20 - \$6.90$.
31. $\$8072 - \$6993$.

ORAL EXERCISE

If you owe the following sums, find how much change you should receive from $1 in each case:

1.	90¢	95¢	80¢	85¢	70¢	75¢	88¢	92¢	81¢
2.	30¢	60¢	45¢	38¢	49¢	62¢	36¢	43¢	77¢
3.	10¢	20¢	25¢	35¢	41¢	33¢	66¢	79¢	89¢

If you owe the following sums, find how much change you should receive from $2 in each case:

4.	$1.25	$1.50	$1.75	$1.80	$1.90	$1.95
5.	$1.35	$1.38	$1.62	$1.56	$1.88	$1.17
6.	$1.82	$1.61	$0.75	$1.20	$1.32	$1.44

If you owe the following sums, find how much change you should receive from $5 in each case:

7.	$2.25	$3.25	$4.75	$2.80	$3.50	$1.50
8.	$3.80	$4.10	$2.60	$1.40	$2.10	$4.15
9.	$2.78	$3.75	$4.60	$3.90	$2.01	$3.07

WRITTEN EXERCISE

Subtract, and check the work:

1.	2.	3.	4.	5.
$281.42	$691.75	$298.30	$427.20	$532.60
135.02	208.02	107.60	109.32	237.62

6.	7.	8.	9.	10.
$532.65	$281.92	$409.72	$672.35	$491.63
206.39	192.60	286.58	148.39	269.75

WRITTEN EXERCISE

1. How much more is 224 than 187?

2. How much less is 224 than 301?

3. How much more is the sum of 426 and 182 than the sum of 97 and 58?

4. How much less is the sum of 196 and 259 than the sum of 437 and 296?

5. A farmer who had 235 chickens sold 86 of them. How many chickens had he left? He then bought 52 chickens. How many chickens did he then have?

6. A farmer had 68 sheep. After buying 75 more, how many did he have? If he then sold 40 sheep, how many sheep were left?

7. A man's income for a year is \$1500 and \$280, and his expenses are \$1275. How much does he save?

8. A man's salary is \$1400 a year, and he receives \$180 from a house which he rents. His expenses are \$1142. How much does he save?

9. How many more boy scouts are there in a regiment made up of 76 boys under twelve years of age and 89 boys over twelve years of age than there are in a regiment of 144 boys?

10. A village has 1207 inhabitants, and 168 of them go away on an excursion. How many do not go?

11. A boy had a kite string 428 ft. long. He tied on 356 ft. more, and then lost 68 ft. in a tree. How many feet of string were left?

WRITTEN REVIEW

Add the following:

1.	123	183	189	286	474	$2.39
	472	472	472	493	298	3.48
2.	392	286	758	538	398	$4.56
	489	509	177	269	477	4.81
3.	287	568	429	377	622	$2.77
	387	296	492	478	398	6.43
4.	249	287	488	526	485	$2.98
	393	573	296	375	275	4.37

Subtract the following:

5.	586	526	581	521	562	$6.91
	231	231	236	236	375	4.93
6.	428	532	631	741	921	$9.07
	169	274	227	268	329	6.59
7.	722	653	917	642	753	$8.11
	434	346	289	485	368	2.98
8.	654	716	723	820	620	$9.23
	278	257	334	216	325	4.75
9.	500	600	632	704	800	$7.10
	417	522	333	650	488	2.96

OPTIONAL PROBLEMS

1. The owner of a garage had 175 gal. of gasoline at the beginning of a month. During the month he bought 1200 gal. more and sold 975 gal. How many gallons had he left at the end of the month?

2. A certain freight elevator can safely carry 1500 lb. The elevator man weighs 178 lb., and he has 10 kegs of nails weighing 107 lb. each. How many more pounds can the elevator safely carry?

3. Mrs. Clark has $20 to spend for draperies for a door and some windows. She pays $12.24 for the draperies for the door and finds that she needs $7.98 for the windows. How much more money does she need than what she has?

4. Harry's father took him to the Zoo. The fare was 5¢ apiece each way, their luncheon cost 70¢, and Harry had a glass of lemonade costing 3¢, some candy costing 10¢, and some peanuts costing 10¢. What change was left from a $2 bill?

5. The manager of a moving-picture theater took in $1512 last month, but out of that he paid $350 for pictures, $275 for rent, $360 for help, and $135 for other expenses. How much was his net profit?

The *net profit* is the profit after all the expenses have been paid.

6. Last year 372 pupils left a certain school and 486 new ones were admitted. At the end of the year there were 1794 pupils in the school. How many were there at the beginning of the year?

V. MULTIPLICATION

ORAL EXERCISE

1. How much will 8 tables cost at \$7 each?
2. How much will 8 bedroom sets cost at \$70 each?
3. How much will 8 automobiles cost at \$700 each?

State rapidly the following products:

4. 3×7	4×9	6×7	5×8	8×9
5. 6×6	7×6	8×8	6×9	5×6
6. 7×7	5×7	8×6	8×7	7×9
7. 5×9	6×8	9×9	7×8	8×5

In Exs. 4–7 are the groups which are usually found to be the more troublesome up to 10×10.

Recite the following multiplication tables:

8. 2's.	10. 4's.	12. 6's.	14. 8's.	16. 11's.
9. 3's.	11. 5's.	13. 7's.	15. 9's.	17. 12's.

18. What part of the multiplication tables do you find the hardest to remember?

19. To find 7×14 think of 7×10, or 70; then of 7×4, or 28; then of $70 + 28$. How much is 7×14?

Multiply the following:

20. 2×49.	23. 2×47.	26. 5×18.	29. 5×17.
21. 6×16.	24. 4×23.	27. 3×29.	30. 3×27.
22. 5×19.	25. 7×13.	28. 2×43.	31. 2×39.

In Exs. 20–31 are some of the more difficult products less than 100.

WRITTEN EXERCISE

1. Frank sold 3 doz. eggs for 28¢ a dozen. How much money did he receive?

2. If Frank had 84¢, and it costs him 25¢ to go to the theater, how much does he have left?

3. Frank has money enough left (see Ex. 2) to send his sister to the theater and how much more?

4. John worked 6 hr. on Saturdays, and 2 hr. on the afternoons of other days, receiving 12¢ an hour. How much did he earn in 4 Saturdays and 23 afternoons?

5. If Mary saves 16¢ a week, how much money does she save in 15 wk.?

6. Mary wishes to take her aunt and cousin to a concert. Her aunt's ticket will cost 50¢, and the tickets for her cousin and herself will cost 25¢ each. How much money will Mary pay for all three tickets?

7. If Mary receives 4¢ every time she washes the dishes, and washes them twice a day, how much does she earn in 29 da.?

8. Mary's mother sends her to buy 14 yd. of calico. Mary finds that she must pay 13¢ a yard for the kind she needs. How much will it cost?

9. Mary's father buys a typewriter for $75. He pays $48.75 down and asks Mary if she can tell how much more he must pay. What should she tell him?

10. If Mary saves 35¢ a week, how much will she save in a summer vacation of 9 wk.?

WRITTEN EXERCISE

Multiply the following:

1.	2.	3.	4.	5.
135 × 2	\$1.35 × 2	275 × 2	\$12.75 × 2	\$10.20 × 4
6.	**7.**	**8.**	**9.**	**10.**
\$3.75 × 2	\$1.35 × 3	\$7.25 × 3	\$18.60 × 4	\$20.30 × 5
11.	**12.**	**13.**	**14.**	**15.**
\$9.30 × 4	\$8.95 × 4	\$2.33 × 5	\$23.42 × 5	\$24.70 × 6
16.	**17.**	**18.**	**19.**	**20.**
\$4.81 × 6	\$4.09 × 6	\$7.28 × 6	\$43.00 × 7	\$36.75 × 5
21.	**22.**	**23.**	**24.**	**25.**
\$3.09 × 7	\$3.59 × 7	\$4.86 × 8	\$71.93 × 8	\$49.78 × 6
26.	**27.**	**28.**	**29.**	**30.**
\$6.32 × 9	\$2.13 × 9	\$12.75 × 9	\$14.75 × 9	\$82.86 × 8

31. At \$2.25 a yard, how much will 2 yd. of silk cost?

32. At \$3.25 each, how much will 7 desks cost?

33. At \$7.35 each, how much will 8 boys' suits cost?

Jennie's aunt has hired a house and lets out rooms to lodgers. Find what it will cost for the following items:

34. 7 bedroom chairs @ $3.25.

The symbol @ means "at." The pupils have seen this before. When we say "@ $3.25" we always mean "at $3.25 each." But if we speak of 7 doz. oranges @ 50¢, we mean "at 50¢ a dozen," and if we speak of 4 M (that is, 4000) bricks @ $8, we mean "at $8 a thousand." Instead of saying "at $8 a thousand," we often say "at $8 *per* thousand."

35. 2 hall chairs @ $6.75.

36. 14 dining-room chairs @ $3.75.

37. 7 rockers @ $3.70 and 2 rockers @ $3.25.

38. 5 bedsteads @ $4.50 and 2 bedsteads @ $4.75.

39. 6 rugs @ $9.75 and 2 rugs @ $17.75.

40. 4 rugs for the hall and living room @ $32.75.

41. 4 bureaus @ $11.75.

42. Fittings and plumbing for 2 bathrooms @ $42.75.

43. Curtains for 9 rooms @ $5.62 per room.

44. Pillows and bedding for 7 bedrooms @ $28.75.

45. 3 small tables @ $3.28.

46. Electric work and fixtures for 5 rooms @ $16.25 and for 2 rooms @ $21.50.

47. Painting 8 rooms at an average cost of $12.75.

48. 2 cleaners, working 8 hr. a day for 3 da., @ 35¢ per hour.

49. 9 common locks @ 65¢, 1 lock @ $2.50, and 12 keys @ 15¢.

ORAL EXERCISE

1. How much is 10×2? 10×20?
2. To multiply by 10, how many zeros do you annex?
3. How much is 10×25? 10×47?

Multiply the following by 10:

4.	7	70	73	26	27	33	82	52
5.	34	48	29	66	87	41	79	99

6. How much is $10 \times \$3$? $10 \times \$3.00$?
7. How much is $10 \times \$15$? $10 \times \$15.75$?
8. How much is $10 \times \$21.50$? $10 \times \$100$?

Multiplying by 10's. *To multiply by 10, annex a zero. If there is a decimal point, move it one place to the right.*

Thus $10 \times 75 = 750$, and $10 \times \$7.50 = \$75.00$.

The result of both $10 \times \$3$ and $10 \times \$3.00$ is \$30. We may write this as \$30, or as \$30.00. The product of $10 \times \$1.25$ is \$12.50, not \$12.5, it being the custom to have two figures to represent the cents, putting in a zero if necessary.

To multiply a number by 100, annex two zeros. Move any decimal point two places to the right.

To multiply a number by 20, multiply by 2 and multiply the product by 10.

To multiply by 200, multiply by 2 and multiply the product by 100.

25	32
20	300
500	9600

We write the numbers and express the work as shown above in the multiplication of 25 by 20 and of 32 by 300.

WRITTEN EXERCISE

Multiply the following by 10:

1.	$2.75	$12.75	$22.75	$25.50
2.	$26.00	$48.30	$53.25	$69.73
3.	$82.96	$100.00	$200.00	$500.00

Multiply the following by 20:

4.	42	36	81	53	67
5.	39	$1.20	$2.20	$3.50	$2.23
6.	$4.50	$5.70	$4.90	$7.75	$9.65

Multiply the following by 100:

7.	4	22	45	50	81	75	42	86
8.	77	36	83	87	63	66	29	99

Multiply the following by 200:

9.	5	8	7	9	6	15	18	25
10.	35	41	48	55	46	60	67	75

11. At $2 each, how much will 30 chairs cost?
12. At $3 each, how much will 40 tables cost?
13. At $5 each, how much will 50 desks cost?
14. At $6 each, how much will 70 coats cost?
15. At $32 each, how much will 20 bedroom sets cost?
16. At $60 each, how much will 30 typewriters cost?
17. At $3.50 each, how much will 20 hats cost?
18. At $17.50 each, how much will 20 office desks cost?
19. At $22.75 each, how much will 30 overcoats cost?

WRITTEN EXERCISE

1. How much will 10 doz. pencils cost at 30¢ a dozen? at 36¢ a dozen? at 42¢ a dozen?

2. How much will 10 boxes of crayons cost at 35¢ a box? at 38¢ a box? at 43¢ a box?

3. At 10¢ apiece, how much will 2 doz. blackboard pointers cost? How much will 3 doz. cost?

4. At 10¢ a small package, how much will half a dozen small packages of pens cost?

5. How many fingers have the pupils in a class of 27? How many toes? How many fingers and toes?

6. If an arithmetic costs 35¢, how much must be paid for 10 arithmetics? for 20 arithmetics?

7. If a book costs $1.25, how much must be paid for 10 such books? for 20 such books? for 30 such books?

8. At $12.75 each, how much must a dealer pay for 40 suits of boys' clothes? for 60 suits?

9. At $38.25 each, how much must a dealer pay for 30 bedroom sets? for 40 sets? for 60 sets?

10. At $32.50 each, how much must a dealer pay for 80 automobile tires? for 90 tires? for 70 tires?

11. At $45.50 each, how much must a furniture dealer pay for 50 dining-room sets? for 20 sets? for 40 sets?

12. At $37.75 each, how much must a dealer pay for 80 office desks? for 70 desks? for 30 desks?

13. At $87.50 each, how much must a dealer pay for 20 Texas ponies? for 30 Texas ponies?

Two-Figure Multiplier. To multiply \$2.75 by 54, we write the numbers as here shown.

We multiply in the usual way, first by 4 units and then by 5 tens.

In the product we place the decimal point between dollars and dimes.

The product is \$148.50.

\$2.75
54
11 00
137 5
\$148.50

Teachers who feel that the class needs a more complete explanation may refer back to page 28.

WRITTEN EXERCISE

Multiply the following:

1. \$4.82 by 15.	**6.** \$1.23 by 12.	**11.** \$3.27 by 62.
2. \$4.09 by 19.	**7.** \$2.17 by 32.	**12.** \$3.96 by 28.
3. \$2.81 by 38.	**8.** \$3.41 by 29.	**13.** \$1.39 by 39.
4. \$2.99 by 27.	**9.** \$4.80 by 36.	**14.** \$1.75 by 68.
5. \$0.69 by 73.	**10.** \$5.60 by 71.	**15.** \$0.75 by 89.

16. At \$24 a dozen, how much will 24 silver tablespoons cost? How much will 24 doz. cost?

17. At \$36 a dozen, how much must a dealer pay for 4 cut-glass vases? for 26 doz.? for 15 doz.?

18. At \$7 each, how much will 12 armchairs cost?

Multiply the following:

19. $23 \times \$2.56$.	**22.** $41 \times \$3.45$.	**25.** $52 \times \$2.86$.
20. $28 \times \$3.91$.	**23.** $43 \times \$3.05$.	**26.** $75 \times \$3.08$.
21. $75 \times \$4.00$.	**24.** $75 \times \$4.50$.	**27.** $36 \times \$5.50$.

WRITTEN EXERCISE

In solving these examples in multiplication see how large a score you can make in five minutes, counting every correct result 1, and subtracting 2 for every incorrect result:

1.	2.	3.	4.	5.	6.
\$2.50	\$3.65	\$4.80	\$5.25	\$12.50	\$27.62
31	22	34	42	44	20

7.	8.	9.	10.	11.	12.
\$4.60	\$7.95	\$5.92	\$9.37	\$13.75	\$52.96
22	26	36	39	64	30

13.	14.	15.	16.	17.	18.
\$5.80	\$8.34	\$8.75	\$9.99	\$48.70	\$99.99
75	27	48	99	82	90

19. A clothing dealer bought 75 suits of clothes at \$12.25 each. How much did he pay for the lot?

20. A dealer bought 48 automobiles at \$427.50 each. How much did he pay for the lot?

Multiply the following:

21.	22.	23.	24.	25.
\$425.25	\$275.05	\$162.73	\$421.11	\$228.96
32	34	36	71	30

26.	27.	28.	29.	30.
\$326.45	\$241.36	\$432.47	\$225.25	\$600.09
28	35	26	88	80

Three-Figure Multiplier. **1.** A city dealer buys 234 automobiles at $348 per car. How much do the cars cost him?

We see that we must multiply $348 by 234.

We multiply by 4, and write the product, 1392, so that the right-hand figure (2) is in the ones' place. We then multiply by 3, and write the product, 1044, so that the right-hand figure (4) is in the tens' place.

We then multiply by 2, and write the product, 696, so that the right-hand figure (6) is in the hundreds' place.

$$\begin{array}{r} \$348 \\ 234 \\ \hline 1392 \\ 1044 \\ 696 \\ \hline \$81432 \end{array}$$

The product is $81,432, and this is the cost of the cars.

2. If the dealer buys 240 cars at $720 each, how much do the cars cost him?

To multiply by 240 is the same as to multiply by 10×24. We multiply by 10 by annexing 0, and so we may multiply $720 by 24 and annex 0 as here shown.

The product is $172,800, the total cost.

$$\begin{array}{r} \$720 \\ 240 \\ \hline 28800 \\ 1440 \\ \hline \$172800 \end{array}$$

WRITTEN EXERCISE

Multiply the following:

1.	2.	3.	4.	5.	6.
231	231	439	575	$575	$356
111	123	123	222	322	550
7.	**8.**	**9.**	**10.**	**11.**	**12.**
243	348	329	426	$527	$481
126	241	423	178	136	670

WRITTEN EXERCISE

Multiply the following:

1. 131×427.	7. 362×648.	13. 375×702.
2. 101×363.	8. 407×942.	14. 406×1475.
3. 242×787.	9. 387×682.	15. 368×3209.
4. 303×525.	10. 805×377.	16. 402×2008.
5. 575×766.	11. 994×782.	17. 498×2007.
6. 909×999.	12. 809×698.	18. 909×1009.

19. How much will a dealer pay for 225 hats at \$1.25 each?

20. A dealer buys 15 rugs at \$17.75 each, and 36 rugs at \$28.50 each. How much does he pay in all?

Find the cost of:

21. 121 locomotives at \$9875 each.
22. 216 passenger cars at \$3950 each.
23. 162 yd. of Wilton carpet at \$1.65 a yard.
24. 272 yd. of silk at \$1.15 a yard; at \$1.25 a yard.
25. 112 building lots at \$1375 each; at \$1250 each.
26. 135 automobiles at \$2450 each; at \$1875 each.
27. 102 delivery wagons at \$137.50 each.

Multiply the following:

28. \$67.56 by 400; by 406; by 409; by 405; by 410.
29. \$29.30 by 500; by 504; by 507; by 508; by 509.
30. \$35.25 by 600; by 609; by 807; by 808; by 987.

WRITTEN EXERCISE

Multiply the following:

1.	2.	3.	4.	5.
\$142.50	\$276.30	\$489.72	\$896.63	\$527.30
21	41	52	75	64

6.	7.	8.	9.	10.
\$426.30	\$462.75	\$329.82	\$472.96	\$309.87
68	39	98	89	72

11.	12.	13.	14.	15.
\$481.20	\$502.75	\$681.39	\$17.42	\$21.50
64	69	72	146	371

16.	17.	18.	19.	20.
\$491.76	\$482.75	\$536.47	\$671.70	\$879.90
381	243	328	426	897

21. At \$85 each, how much must a dealer pay for 164 rugs? for 127 rugs? for 169 rugs?

22. At \$37.50 each, how much must a fur dealer pay for 38 sets of fur? for 43 sets? for 92 sets?

23. At 36¢ a dozen, how much must a restaurant keeper pay for 24 eggs? for 24 doz. eggs?

24. If the school buys 15 dictionaries at \$6.75 each, how much will it pay for all?

25. A grocer buys coffee at 18¢ a pound and sells it for 4¢ a pound more than it cost him. How much does he receive for 13 lb.?

OPTIONAL PROBLEMS

1. On an average there were 328 immigrants landed in New York on each of the 365 da. of a certain year. How many landed in that year?

2. When Henry was 1 yr. old his aunt put \$2.50 in the bank for him, and she did this on every birthday until Henry was 21 yr. old. How much did she put in the bank for him in all?

3. For a dress Julia's sister used 4 yd. of serge at 67¢ a yard, and the trimming cost \$1.25. She paid \$2.50 for making the dress. What was the whole cost?

4. A man took his wife and 2 children for a day's outing at the seashore. It cost for each of the four 20¢ for carfare and 25¢ for bathing. The lunch cost \$1.80 for all of them and there were other expenses of \$1.20. How much did the trip cost?

5. In a gymnasium meet, 346 pupils paid 15¢ each. There was also a gift of \$13 from a friend of the school. How much was taken in altogether?

6. Harry had an average of 48 customers for a 5-cent weekly paper during the first 19 weeks of the year, and an average of 64 customers during the rest of the year. How much money did he collect during the year?

The year ordinarily has 52 wk. 1 da. (leap years have 52 wk. 2 da.), but in solving problems instruct the pupils to take 52 wk. to the year.

7. John receives 25¢ every week for spending money. At the end of 12 wk. he has saved 95¢. How much did he spend in that time?

8. A dress pattern requires 3 yd. of material 54 in. wide, or 6 yd. of material 36 in. wide. The 54-inch goods cost \$1.05 a yard, and the 36-inch goods cost 59¢ a yard. Which is it cheaper to buy?

9. A tailor charges 50¢ to press a suit of clothes and \$1.50 to clean one. A mother gives her boy \$5 out of which to pay for the cleaning of two suits and the pressing of one suit. How much change should he get?

10. A boy got a job at the end of his summer vacation which paid him 75¢ for working Saturday afternoons. Each week he spent 30¢ and put the rest of his wages into the savings bank. If he worked 15 Saturdays, how much did he put into the bank?

11. A real-estate dealer earned \$375 last month by renting apartments, but out of this he paid \$80 for office rent, \$84 for office help, and \$36.50 for other expenses. How much was his net profit?

12. A bookkeeper receiving \$15.50 a week is promoted to a position paying \$75 a month. How much more does he receive a year?

13. A contractor hired 26 men at \$1.75 a day for 26 da. How much did he have to pay them?

14. Henry wanted to save enough money to buy his mother a present. He earned 35¢ by doing errands for the neighbors, and twice he saved 10¢ by walking instead of using the money given him for the trolley car. He helped a man at a news stand 6 afternoons, receiving 15¢ each time. How much did he save in all?

VI. DIVISION

Factors and Multiples. If we multiply 3 by 2 the result is 6, and we call 6 a *multiple* of 2 and also of 3. Likewise we call 12 a multiple of 2, of 3, of 4, and of 6.

We call 2 and 3 the *factors* of 6, and we call 2, 3, 4, and 6 each a factor of 12.

A number which is written without any fraction is called a *whole number* or *integer*. Thus 2 is a whole number, but $\frac{3}{4}$ is a *fraction* and $2\frac{3}{4}$ is a *mixed number*.

A whole number is also called an *integer*. We do not speak of 1 or of a fraction as a factor of a number. For example, although $2 \times 1 = 2$, and $4 \times \frac{1}{2} = 2$, we do not speak of 1 or of $\frac{1}{2}$ as factors of 2.

Because $2 \times 3 = 6$ we see that, if we have the product 6 and one factor 2, we find the other factor by dividing, thus:

$$6 \div 2 = 3.$$

Explain how to find the second factor of 100 when 2 is given as one factor. Show the pupils that this is easily done mentally.

ORAL EXERCISE

The first number in each of these examples is the product of two numbers of which I am thinking, and the second is one of these numbers; find the other number:

1. 99; 3.	**6.** 93; 3.	**11.** 87; 3.	**16.** 81; 3.
2. 98; 7.	**7.** 92; 4.	**12.** 86; 2.	**17.** 78; 3.
3. 96; 8.	**8.** 91; 7.	**13.** 85; 5.	**18.** 76; 4.
4. 95; 5.	**9.** 90; 5.	**14.** 84; 7.	**19.** 72; 4.
5. 94; 2.	**10.** 88; 4.	**15.** 82; 2.	**20.** 57; 3.

ORAL EXERCISE

1. I am thinking of two numbers whose product is 102. One of the numbers is 2. What is the other?

2. I am thinking of two numbers whose product is 104. One of the numbers is 4. What is the other?

I am thinking of two numbers whose product is the first of each of the following pairs of numbers; one of the numbers is the second of the pair; find the other number:

3. 110; 5.	6. 119; 7.	9. 128; 8.	12. 135; 5.
4. 111; 3.	7. 125; 5.	10. 129; 3.	13. 138; 6.
5. 117; 9.	8. 126; 7.	11. 133; 7.	14. 141; 3.

WRITTEN EXERCISE

The first number in each example is the product of two factors, and the second number is one of these factors; find the other factor:

1. 102; 17.	7. 119; 17.	13. 125; 25.
2. 104; 13.	8. 123; 41.	14. 126; 21.
3. 105; 15.	9. 124; 31.	15. 128; 32.
4. 106; 53.	10. 132; 22.	16. 129; 43.
5. 112; 16.	11. 134; 67.	17. 130; 26.
6. 114; 19.	12. 136; 17.	18. 133; 19.

19. I am thinking of two numbers whose product is 319. One of the numbers is 29. What is the other?

20. I am thinking of two numbers whose product is 589. One of the numbers is 19. What is the other?

ORAL EXERCISE

1. If you have 10¢, how many oranges can you buy at 4¢ each, and how much money will you have left?

2. If you have 25¢, how many oranges can you buy at 6¢ each, and how much money will you have left?

In each of the following cases state the quotient and also the remainder, if any:

3. Divide by 2: 17, 24, 30, 35, 44, 45.
4. Divide by 3: 15, 16, 17, 27, 29, 35, 39, 41.
5. Divide by 4: 20, 21, 22, 23, 36, 37, 45, 50.
6. Divide by 5: 30, 31, 32, 34, 47, 52, 63, 65.
7. Divide by 6: 24, 25, 26, 35, 42, 45, 54, 58.
8. Divide by 7: 21, 23, 35, 39, 56, 58, 72, 142.
9. Divide by 8: 13, 24, 27, 33, 45, 57, 66, 163.
10. Divide by 9: 11, 45, 49, 54, 65, 75, 82, 185.

WRITTEN EXERCISE

1. A dealer has $350 to spend for boys' suits. He pays $12 a suit. How many suits does he buy, and how much money does he have left?

2. How many inches are there in 15 ft.? How many strips of carpet, 27 in. wide, can be laid in a room 15 ft. wide, and how many inches will be left uncovered?

Find the quotients and remainders:

3. $6248 \div 25$.
4. $4189 \div 32$.
5. $18{,}245 \div 37$.
6. $16{,}007 \div 65$.
7. $38{,}426 \div 27$.
8. $81{,}909 \div 75$.

WRITTEN EXERCISE

1. If a dealer pays \$1935 for 43 sets of furniture, how much does he pay a set?

2. An agent sells 23 sewing machines for \$483. How much does he receive for each?

3. The total school attendance for 23 da. in our room was 805. What was the average daily attendance?

4. A city dealer bought 25 children's bicycles for \$275. How much did they cost apiece?

5. At \$71 each, how many Texas ponies can be bought for \$1491? How many can be bought for \$1562?

6. An express train ran 559 mi. in 13 hr. What was the rate per hour?

7. How many street cars, each carrying 72 persons, will it take to carry 3312 persons?

8. An agent rents 64 apartments for \$2112 a month. How much is that for each apartment?

9. How many hours will it take an automobile to go 1254 mi., if it goes at the rate of 19 mi. an hour?

10. A family has \$1265 with which to make a trip to Europe that will take 55 da. How much can they spend on an average per day?

Divide the following:

11. $38{,}178 \div 63$.	14. $78{,}408 \div 99$.	17. $69{,}375 \div 75$.
12. $30{,}456 \div 94$.	15. $84{,}864 \div 52$.	18. $89{,}568 \div 96$.
13. $26{,}896 \div 82$.	16. $54{,}432 \div 84$.	19. $37{,}950 \div 75$.

Convenient Products. The products given on page 32 are found to be useful also in division. For example,

because we know that $2 \times 23 = 46$,
we see that $46 \div 2 = 23$,
and $46 \div 23 = 2$.

ORAL EXERCISE

State the following quotients:

1. $32 \div 2$.	**4.** $28 \div 14$.	**7.** $30 \div 15$.	**10.** $42 \div 14$.
2. $48 \div 2$.	**5.** $34 \div 17$.	**8.** $44 \div 22$.	**11.** $48 \div 16$.
3. $39 \div 3$.	**6.** $32 \div 16$.	**9.** $39 \div 13$.	**12.** $45 \div 15$.

Division of Money. We divide numbers representing money very much as we divide other numbers. For example, we divide \$25.76 by 8 as here shown, being careful to place the decimal point in the quotient exactly below the decimal point in the dividend.

$$8)\$25.76$$
$$\$3.22$$

WRITTEN EXERCISE

Divide the following:

1. \$49.71 ÷ 3.	**7.** \$87.46 ÷ 2.	**13.** \$411.76 ÷ 2.
2. \$39.84 ÷ 4.	**8.** \$97.35 ÷ 3.	**14.** \$411.03 ÷ 3.
3. \$63.36 ÷ 6.	**9.** \$79.32 ÷ 4.	**15.** \$706.35 ÷ 5.
4. \$64.47 ÷ 7.	**10.** \$81.15 ÷ 5.	**16.** \$400.02 ÷ 6.
5. \$97.68 ÷ 8.	**11.** \$87.30 ÷ 6.	**17.** \$713.28 ÷ 8.
6. \$70.02 ÷ 9.	**12.** \$95.12 ÷ 8.	**18.** \$627.03 ÷ 9.

Dividing Dollars and Cents. 1. A man paid \$5 for four sleds for his boys. How much did he pay for each sled?

Each sled cost $\frac{1}{4}$ of \$5, or \$5 ÷ 4, so we must know how to divide \$5 by 4.

We write \$5.00 for \$5 and divide just as we do with other numbers, placing the decimal point in the quotient exactly below the decimal point in the dividend.

$$4)\$5.00$$
$$\$1.25$$

The quotient is \$1.25, so he paid \$1.25 for each sled.

2. A dealer paid \$28.35 for 21 sleds. How much did he pay for each sled?

For each sled he paid \$28.35 ÷ 21.

We divide just as we do with other numbers, placing the decimal point in the quotient exactly above the decimal point in the dividend. The quotient is \$1.35, so he paid \$1.35 for each sled.

We check our work by multiplying \$1.35 by 21, the result being \$28.35.

$$\begin{array}{r} \$1.35 \\ 21\overline{)\$28.35} \\ 21 \\ \hline 73 \\ 63 \\ \hline 105 \\ 105 \\ \hline \end{array}$$

WRITTEN EXERCISE

Divide the following:

1. \$7 ÷ 5.
2. \$2.70 ÷ 5.
3. \$15.12 ÷ 7.
4. \$25.92 ÷ 9.
5. \$5.40 ÷ 12.
6. \$5.40 ÷ 15.
7. \$5.04 ÷ 14.
8. \$8.64 ÷ 27.
9. \$32.40 ÷ 12.
10. \$75.60 ÷ 14.
11. \$15.12 ÷ 56.
12. \$25.92 ÷ 54.

13. A school pays \$79.20 for 11 tables. How much does each table cost?

Three-Figure Divisor. To divide 12,525 by 501 we write the numbers in the same way as in other cases of division.

Since $12 \div 5$ is a little more than 2, we see that $1252 \div 501$ is also more than 2, but less than 3.

Since $2 \times 501 = 1002$, we subtract, and there is a remainder of 250 tens.

Since we divided 1252 tens, we write the 2 in the quotient over the tens.

$$\begin{array}{r} 25 \\ 501\overline{)12525} \\ 1002 \\ \hline 2505 \\ 2505 \\ \hline \end{array}$$

Bringing down the next figure as usual, we have 2505.

Since $2505 \div 501 = 5$, we write the 5 as the next figure.

The quotient is therefore 25.

Check. $25 \times 501 = 12{,}525$.

If the quotient figure is taken too large, the partial product will be greater than the corresponding part of the dividend. In this case, try a smaller quotient figure.

If the quotient figure is taken too small, the remainder will be greater than the divisor. In this case, try a larger quotient figure.

WRITTEN EXERCISE

Divide the following:

1. $1284 \div 321$.
2. $5733 \div 273$.
3. $1415 \div 283$.
4. $8450 \div 325$.
5. $9683 \div 421$.
6. $9541 \div 329$.
7. $7398 \div 274$.
8. $3675 \div 525$.
9. $3552 \div 888$.
10. $1926 \div 321$.
11. $3024 \div 432$.
12. $7011 \div 171$.
13. $2250 \div 372$.
14. $7446 \div 213$.
15. $9174 \div 275$.

WRITTEN EXERCISE

Divide the following:

1. 15,000 ÷ 125.
2. 29,000 ÷ 125.
3. 17,250 ÷ 125.
4. 25,984 ÷ 116.
5. 77,604 ÷ 116.
6. 86,229 ÷ 201.
7. 76,708 ÷ 302.
8. 50,470 ÷ 245.
9. 93,632 ÷ 176.
10. 87,143 ÷ 211.
11. 93,860 ÷ 247.
12. 91,739 ÷ 199.
13. 85,158 ÷ 249.
14. 87,648 ÷ 249.
15. 87,318 ÷ 231.
16. 91,791 ÷ 217.
17. 65,649 ÷ 237.
18. 84,300 ÷ 281.
19. 17,000 ÷ 125.
20. 16,875 ÷ 125.
21. 29,375 ÷ 125.
22. 51,736 ÷ 116.
23. 52,576 ÷ 212.
24. 28,644 ÷ 231.
25. 70,512 ÷ 226.
26. 32,568 ÷ 236.
27. 79,442 ÷ 314.
28. 69,834 ÷ 226.
29. 72,670 ÷ 215.
30. 79,692 ÷ 229.
31. 82,450 ÷ 194.
32. 79,808 ÷ 232.
33. 78,200 ÷ 184.
34. 69,687 ÷ 267.

35. If 98 machines cost a dealer $34,594, what is the cost of each machine?

36. If 175 tons of coal cost $1225, what is the cost of the coal per ton?

37. If 405 sewing machines cost a dealer $14,175, how much did he pay for each machine?

ORAL EXERCISE

1. How many 10's in 30? in 100? in 700? in 1000?
2. How many 20's in 40? in 400? in 800? in 2000?
3. How many 100's in 300? in 700? in 8000?
4. Divide 500 by 5; 500 by 10; 500 by 50.

Divisor Ending in Zeros. To divide 24,000, 24,357, and 25,357 by 2000, we proceed as follows:

$$2\not{0}\not{0}\not{0})24\not{0}\not{0}\not{0} \qquad 12$$

$$2\not{0}\not{0}\not{0})24\not{3}\not{5}\not{7} \qquad 12\frac{357}{2000}$$

$$2\not{0}\not{0}\not{0})25\not{3}\not{5}\not{7} \qquad 12\frac{1357}{2000}$$

That is, we *cancel* (cross out) the zeros at the right of the divisor and cancel as many figures at the right of the dividend as we cancel zeros of the divisor, writing the complete remainder over the divisor.

Canceling the three zeros in 24,000 divides by 1000. Then dividing the rest by 2, we have divided by 2000.

The teacher should take up these examples in order, showing that the numerator of the fraction is the remainder in each case.

Such a fraction in a quotient is to be looked upon merely as an expression of division.

WRITTEN EXERCISE

Divide the following:

1. $6000 \div 300$.
2. $6007 \div 300$.
3. $6107 \div 300$.
4. $4000 \div 200$.
5. $4009 \div 200$.
6. $4109 \div 200$.
7. $69{,}107 \div 300$.
8. $102{,}107 \div 6000$.
9. $147{,}111 \div 7000$.

WRITTEN EXERCISE

Divide the following:

1. $2450 \div 49$.
2. $3479 \div 49$.
3. $4459 \div 49$.
4. $5292 \div 98$.
5. $3087 \div 98$.
6. $3087 \div 21$.
7. $6897 \div 57$.
8. $1829 \div 59$.
9. $6848 \div 32$.

In each of the following examples divide each number in columns d to h by each number in columns a, b, and c:

	a	*b*	*c*	*d*	*e*	*f*	*g*	*h*
10.	3	6	12	36	180	540	1080	32,400
11.	5	15	45	90	270	540	1620	81,000
12.	7	14	28	56	168	504	1512	75,600
13.	9	27	54	108	432	864	2592	77,760
14.	11	33	66	198	396	792	3168	63,360
15.	13	39	78	234	468	936	4680	93,600
16.	14	28	56	224	448	896	2688	80,640
17.	15	45	90	450	900	2700	5400	43,200
18.	17	34	68	136	272	2720	5440	48,960
19.	21	42	84	168	336	2352	4704	32,928

That is, in Ex. 10, divide as follows: $d \div a$, $d \div b$, $d \div c$; $e \div a$, $e \div b$, $e \div c$; $f \div a$, $f \div b$, $f \div c$; $g \div a$, $g \div b$, $g \div c$; and $h \div a$, $h \div b$, $h \div c$. There are, therefore, fifteen divisions in each example, or 150 in all. As many may be given as necessary.

For especially apt pupils the teacher may care to give some further drill with three-figure divisors or even with divisors of more than three figures. In that case it should be observed that, in every row, every number to the right of column *a* is exactly divisible by every number which precedes it in the row.

Teachers are urged to read and be guided by the note on page 36.

Long Division of Money. We found on page 108 how to divide money by a number of two figures. In the same way we can divide by a number of three figures. For example, to divide \$233.28 by 288 we write the numbers as here shown. The quotient is \$0.81. This means that if we divide \$233.28 into 288 equal parts there are 81¢ in each part.

$$
\begin{array}{r}
\$0.81 \\
288\overline{)\$233.28} \\
2304 \\
\hline
288 \\
288 \\
\hline
\end{array}
$$

For another example, divide \$295.75 by 176. We write the numbers as here shown. The quotient is \$1.68 and the remainder is 7¢. This means that if we divide \$295.75 into 176 equal parts there is \$1.68 in each part, and there is a remainder of 7¢ which is not divided. The quotient is $\$1.68\frac{7}{176}$, but such a small fraction as $\frac{7}{176}$ of a cent is usually neglected.

$$
\begin{array}{r}
\$1.68 \\
176\overline{)\$295.75} \\
176 \\
\hline
1197 \\
1056 \\
\hline
1415 \\
1408 \\
\hline
7
\end{array}
$$

WRITTEN EXERCISE

1. A dealer paid \$425.60 for 112 tables. How much did he pay for each table?

Divide, finding the quotients and remainders, if any:

2. \$316.80 ÷ 198.
3. \$108.80 ÷ 136.
4. \$975.60 ÷ 242.
5. \$777.60 ÷ 144.
6. \$825.75 ÷ 325.
7. \$369.60 ÷ 528.

OPTIONAL PROBLEMS

1. Last month the luncheon committee at a school made a profit of $14.28. If there were 21 school days in the month, how much was the average gain per day?

2. A mothers' club sold 124 tickets for a school concert and received $18.60. Fred's mother asked him how much the tickets were apiece, but he had forgotten. How much were they?

3. In a school savings bank the 39 boys in a 4 B class deposited $60.84 in a year. Find the average for each.

4. In Ex. 3, if 13 of the boys did not put in any money, what was the average for each of the others?

5. For a folk dance 14 girls made their own costumes, paying $4.50 for the goods and $1.80 for ribbon. What was each girl's share of the expense?

6. Mary's club of 15 girls had a party in the park. The car fares were $2.80, the ice cream and pop corn cost $1.85, and the lunches cost $2.10. What was each girl's share of the expense?

7. In a certain school there are 429 pupils in 11 classes of the lower grades, and 293 pupils in 8 classes of the upper grades. What is the average number of pupils in each class of the whole school?

8. Three classes wish to plant a tree on Arbor Day. The first class has 42 pupils, the second has 45, and the third has 38. If the tree costs $5, how much should each pupil contribute?

9. A school building has seats for 1426 pupils in the classrooms. There are 2 classrooms on the first floor, 12 on the second floor, 13 on the third floor, and 4 on the fourth floor. What is the average number of seats in each classroom?

10. Mary's mother is looking for a new home. One agent offered her a flat for $28 a month, and another agent offered her the same flat for $324 a year. Which was the cheaper per month, and how much cheaper?

11. A grocer receives a crate holding 360 eggs. He finds that 5 eggs are broken, and he puts the rest into boxes holding a dozen each. How many boxes can he fill, and how many eggs will be left over?

12. Harriet's mother has 500 sample cakes of soap to sell at a fair. She sells 380 cakes and divides the rest equally among the 8 girls who helped at her stand. How many cakes did each girl get?

13. A man gives his wife $80 every month to run the house. Out of this she has to pay $40.50 for rent, insurance, and clothes, and in addition to this she saves $5. She then divides the rest into 30 equal parts to see how much she can allow for other living expenses per day. How much can she allow?

14. A man's wages are $22.50 a week, out of which he sets aside $19.20 for home expenses and savings, using the rest for carfares and lunches. There being 6 working days in a week, how much does he have each day for carfare and lunch?

15. Harold is practicing for the 100-yard dash. In nine trials his time in seconds is 15, 14, 16, 14, 13, 14, 15, 13, and 14. Find his average record.

16. A baker uses 3 lb. of flour to make 4 loaves of bread, and he bakes 588 loaves in a week. How many pounds of flour does he use?

In such examples use the horizontal line between multipliers and divisors, thus: $\frac{3 \times 588}{4}$. The teacher may anticipate the use of cancellation in such cases if desired. In Ex. 17 the work may be indicated thus: $\frac{3 \times 588}{4 \times 196}$.

17. In Ex. 16, how many full barrels of flour, each containing 196 lb., does the baker use, and how many pounds over?

18. Harry bought 200 picture postcards for \$3.70 and sold them all at the rate of 2 cards for 5¢. How much did he gain?

19. A janitor receives \$270 for cleaning 25 classrooms 90 times. How much is this per classroom per time?

20. Ruth's mother bought 5 qt. of apples for a Thanksgiving party, paying 8¢ a quart. She found that she had bought 36 apples. How much cheaper was this than buying the same number of apples at 2 for 5¢?

21. A dealer had 162 tons of coal when the weather turned cold and he could get no more. He delivered 34 tons to each of 2 apartment houses, and 3 tons to each of 20 families. He divided the rest equally among 17 families. How much did each of these families get?

VII. MEASURES

ORAL EXERCISE

1. How many feet are 8 in. and 4 in.?
2. How many feet are 1 ft. 8 in. and 1 ft. 4 in.?
3. Add 2 hr. 40 min. and 3 hr. 20 min.

Compound Number. When a number is expressed in *two or more measures* it is called a *compound number*. 2 qt. 1 pt. is a compound number.

Compound numbers are added much like other numbers. Thus, to add 10 ft. 9 in. and 6 ft. 8 in., we may think: "9 in. and 8 in. are 17 in., or 1 ft. 5 in.; and 1 ft. + 6 ft. + 10 ft. = 17 ft." Therefore, the sum is 17 ft. 5 in.

ft.	in.
10	9
6	8
17	5

WRITTEN EXERCISE

Add the following:

1.

ft.	in.
17	10
29	10

2.

yd.	in.
16	25
37	13

3.

gal.	qt.
35	2
47	3

4.

ft.	in.
91	7
62	8

5.

yd.	ft.
97	1
63	2
127	0

6.

bu.	pk.
75	2
89	3
66	0

7.

lb.	oz.
89	14
16	6
83	5

8.

ft.	in.
63	2
87	5
135	9

ORAL EXERCISE

1. 18 oz. = 1 lb. + how many ounces?
2. 34 oz. = 2 lb. + how many ounces?
3. Express as pounds and ounces: 10 oz. + 8 oz.
4. Express as feet and inches: 17 in.; 25 in.

Add the following:

5.		6.		7.		8.	
ft.	in.	ft.	in.	lb.	oz.	lb.	oz
7	9	8	11	10	10	15	14
1	3	1	2	1	6	1	4

WRITTEN EXERCISE

Add the following:

1.		2.		3.		4.	
lb.	oz.	lb.	oz.	ft.	in.	ft.	in.
17	9	27	7	47	9	27	10
6	4	14	10	9	8	32	8

5.		6.		7.		8.	
yr.	mo.	yr.	mo.	hr.	min.	min.	sec.
2	8	4	6	4	32	17	40
3	7	5	4	5	30	16	32

9.		10.		11.		12.	
lb.	oz.	ft.	in.	ft.	in.	da.	hr.
24	13	2	7	23	4	15	19
4	12	3	9	19	8	12	17
16	8	5	6	6	7	6	20

ORAL EXERCISE

Subtract the following:

1.		2.		3.		4.	
lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.
4	12	4	12	4	12	4	12
1	2	3	12		13		14

5.		6.		7.		8.	
ft.	in.	ft.	in.	ft.	in.	ft.	in.
10	8	10	8	10	8	10	8
6	4	6	8		9		10

9. If you and your dog together weigh 71 lb., and the dog weighs 20 lb. 9 oz., how much do you weigh?

Subtracting Compound Numbers. To subtract a number like 14 oz. from 3 lb. 6 oz., we may think of 3 lb. 6 oz. as 2 lb. 22 oz. We then have 2 lb. 22 oz. − 14 oz. = 2 lb. 8 oz.

Similarly 6 lb. 6 oz. − 2 lb. 14 oz. is equal to 5 lb. 22 oz. − 2 lb. 14 oz., or 3 lb. 8 oz.

lb.	oz.
3	6
	14
2	8

WRITTEN EXERCISE

Subtract the following:

1.		2.		3.		4.	
ft.	in.	lb.	oz.	hr.	min.	min.	sec.
275	6	108	4	22	10	51	15
188	9	79	12	9	35	38	42

Subtract the following:

5.		6.		7.		8.	
ft.	in.	ft.	in.	ft.	in.	lb.	oz.
6	8	9	8	12	8	26	8
3	10		10	9	10	19	9

9.		10.		11.		12.	
yd	ft.	qt.	pt.	qt.	pt.	ft.	in.
23	0	23	1	23	0	32	3
17	2	16	0	16	1	16	8

13.		14.		15.		16.	
yr.	mo.	yr.	mo.	gal.	qt.	ft.	in.
3	8	3	8	23	0	42	2
	9	2	9	15	3	19	9

17.		18.		19.		20.	
yr.	mo.	gal.	qt.	ft.	in.	ft.	in.
5	7	48	1	29	10	82	5
1	10	25	2	16	8	15	5

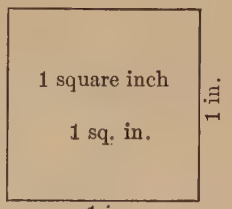
21.		22.		23.		24.	
yd.	ft.	gal.	qt.	bu.	pk.	qt.	pt.
12	1	42	2	42	1	63	0
11	2	29	3	26	2	28	1

25. From 26 yr. 5 mo. take 17 yr. 8 mo.

26. From 3 yr. 2 mo. 15 da. take 1 yr. 3 mo.

27. From the sum of 87 bu. and 9 bu. 2 pk. take the sum of 48 bu. 3 pk. and 10 bu. 3 pk.

Area of a Square or Rectangle. A square that is 1 in. on a side is 1 inch square. The *area* of such a square is 1 square inch.



A square that is 1 ft. on a side is 1 foot square, and the area of such a square is 1 square foot.

If a rectangle is 4 ft. long and 2 ft. wide, there are 2 rows, with 4 square feet in a row. That is, the area is 2×4, or 8, square feet. We usually say that such a rectangle is 2 ft. by 4 ft.

The idea of *area* should be made clear by simple illustrations like the one above. The teacher should explain to the pupils that a rectangle $\frac{1}{2}$ in. by 2 in. contains 1 sq. in., and thus that an area of 1 sq. in. does not require us to have a square that is 1 in. on a side.

Square Measure. The following is the table of square measure:

144 square inches (sq. in.) = 1 square foot (sq. ft.)

9 square feet = 1 square yard (sq. yd.)

WRITTEN EXERCISE

1. If a rectangle is 3 in. long and 2 in. wide, how many square inches has it? Draw the figure, dividing it into inch squares.

2. If a schoolroom is 10 yd. long and 7 yd. wide, how many square yards are there in the floor?

3. If a page of a book is 4 in. by 7 in., how many square inches has it? Draw the figure, dividing it into inch squares.

ORAL EXERCISE

1. The top of a box is a rectangle 3 in. wide and 6 in. long. What is the area?

2. A sheet of paper is 4 in. by 7 in. What is the area?

3. A pane of glass is 9 in. by 10 in. What is the area?

4. A rectangle is 7 in. long and 3 in. wide. What is the area? What is the sum of all the sides?

5. A square is 4 yd. on a side. Find the area, and the sum of all the sides.

The teacher may use the word "perimeter" for "sum of all the sides" if desired. Practice should be given in estimating areas.

WRITTEN EXERCISE

1. Draw a rectangle 6 in. long and 4 in. wide. Find the area and the sum of all the sides.

2. Draw a rectangle half as long and half as wide as the rectangle of Ex. 1. Find the area.

3. Find the area and the sum of all the sides of a rectangle 8 ft. long and 5 ft. wide.

4. A square 6 yd. on a side contains how many square yards? How many yards in the sum of all the sides?

5. A pane of glass is 34 in. long and 22 in. wide. How many square inches does it contain?

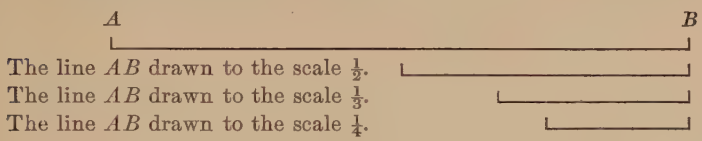
6. Draw a 2-inch square. Draw a 4-inch square. The 2-inch square is equal to what part of the 4-inch square? Find the area and the sum of all the sides of the 2-inch square, and also of the 4-inch square.

DRAWING TO SCALE

1. If we draw a picture of a doll's house and make it $\frac{1}{4}$ as long and $\frac{1}{4}$ as high as the house, we say that we draw the picture *to the scale* of 1 to 4, or to the scale $\frac{1}{4}$.

Every inch in length is then represented by $\frac{1}{4}$ in.

We may draw to other scales. If we represent 1 ft. by 1 in., we say that we draw to the scale of 1 in. to 1 ft. Since there are 12 in. in 1 ft. we also say that we draw to the scale of 1 to 12, writing this as the scale $\frac{1}{12}$.



We frequently write 4′ for 4 ft., 4″ for 4 in., 4′ 8″ for 4 ft. 8 in., and so on.

2. If we draw to the scale $\frac{1}{2}$, by what length shall we represent a line 4 in. long?

3. If we draw to the scale $\frac{1}{3}$, by what length shall we represent a line 12 in. long? a line 15 in. long?

4. If we draw to the scale $\frac{1}{4}$, by what length shall we represent a line 40 in. long? a line 36 in. long?

5. Draw a line to the scale $\frac{1}{4}$ to represent 16 in.

Draw lines to the given scales to represent these lengths:

6. 10 in., $\frac{1}{2}$.
7. 15 in., $\frac{1}{3}$.
8. 12 in., $\frac{1}{4}$.
9. 24 in., $\frac{1}{4}$.
10. 24 in., $\frac{1}{3}$.
11. 24 in., $\frac{1}{6}$.
12. 20 in., $\frac{1}{10}$.
13. 30 in., $\frac{1}{15}$.
14. 36 in., $\frac{1}{9}$.

ORAL EXERCISE

1. Here is a rectangle $2''$ long by $1''$ wide. It is divided into eight squares, each of which is $\frac{1}{2}''$ on a side.

If we make a drawing of this rectangle, making each line half as long as it is here, we have the lower rectangle. We then say that we have drawn the rectangle to the scale $\frac{1}{2}$, or to the scale of 1 to 2, or to the scale of $1''$ to $2''$.

2. A plan of a box lid is drawn to the scale $\frac{1}{2}$. The drawing is $4''$ long. What is the length of the box lid?

3. In a plan of a floor the scale is $1''$ to $1'$. The plan is $14''$ by $16''$. What is the size of the floor?

4. A drawing is made of a leaf of a notebook. The drawing is $3''$ by $6''$ and the scale is $\frac{1}{3}$. What are the dimensions of the leaf?

5. A drawing is made of the cloth back used in binding a book. The drawing is $1''$ by $3''$ and the scale is $\frac{1}{3}$. What are the dimensions of the cloth?

WRITTEN EXERCISE

Draw the plans mentioned above in:

1. Ex. 2. 2. Ex. 3. 3. Ex. 4. 4. Ex. 5.

5. Draw a plan of the floor of your schoolroom.

ORAL EXERCISE

1. If you were to speak of the length of New York State, would you speak of it by miles or by feet?

2. If you were to measure your schoolroom, would you measure by miles, or by feet, or by inches?

3. If you were to measure your finger, would you measure by yards, or by feet, or by inches?

4. If asked your age, would you answer in years, or in months, or in weeks?

Unit of Measure. When we measure anything by feet we call the foot the *unit of measure*. So if we measure weight by the pound, the pound is the unit of measure.

In measuring great lengths we use the mile as the unit. For lengths less than 1 mi. we often use yards or feet. For short lengths we often use the inch.

MEASURING

1. Measure the length of this room, using 1 ft. as the unit; using 1 yd. as the unit.

2. Measure the length of your desk, using 1 ft. as the unit; using 1 in. as the unit.

3. Measure the height of your desk, using 1 ft. as the unit; using 1 in. as the unit.

4. Imagine a square 36 in. on a side. Find its area, using 1 sq. ft. as the unit; also using 1 sq. yd. as the unit. Draw a picture of the square, using 1 in. to a foot.

WRITTEN EXERCISE

1. Measure the length and width of this page and make a drawing of the page to the scale $\frac{1}{2}$.

2. Measure the top of your desk, and make a drawing of it to the scale $\frac{1}{8}$.

3. Measure a page of your geography. Make a drawing of it to the scale $\frac{1}{4}$.

4. A rug is 6 ft. long and 4 ft. wide. Its area is 4×6 sq. ft. Make a drawing of the rug to the scale $\frac{1}{12}$, and in the drawing write the area.

5. The floor of a schoolroom is 40 ft. long and 32 ft. wide. Make a drawing of it to the scale $\frac{1}{8}$ in. to 1 ft. In the drawing write the area of the floor.

Teachers should encourage the pupils to bring problems of their own to class, particularly such as represent real measurements.

Change the following:

6. 5 min. to seconds.
7. 2 hr. to minutes.
8. 3 da. to hours.
9. 12 wk. to days.
10. 15 da. to hours.
11. 52 wk. to days.

12. How many minutes after 9 is 7 min. before 10?

13. How many minutes before 12 is 48 min. after 11?

14. Write the number of days in a year. Then divide this number by the number of days in a week, so as to find the number of weeks in a year.

15. Find the number of hours in a common year, and also the number of hours in a leap year.

Find the areas of the following rectangles:

16. 6 ft. by 17 ft.
17. 12 ft. by 27 ft.
18. 21 in. by 53 in.
19. 12 yd. by 25 yd.
20. 26 yd. by 48 yd.
21. 22 yd. by 75 yd.
22. 23 yd. by 75 yd.
23. 19 ft. by 72 ft.
24. 32 in. by 47 in.
25. 67 in. by 82 in.
26. 33 yd. by 47 yd.
27. 54 ft. by 96 ft.
28. 29 in. by 38 in.
29. 43 ft. by 62 ft.

30. Draw a plan of a square 2 ft. on a side, using $\frac{1}{2}$ in. to represent a foot.

That is, draw the plan to the scale of $\frac{1}{2}$ in. to 1 ft.

31. Draw a plan of a rectangle 2 yd. wide and 3 yd. long, on the scale of 1 in. to the yard.

32. It is 32 in. around a square. What is the length of each side? How many square inches does the square contain?

33. A flower bed in the park is 40 yd. long and 16 yd. wide. How many square yards does it contain? Draw a plan on the scale of 1 in. to 4 yd.

34. A sidewalk is 95 ft. long and 5 ft. wide. How many square feet of area in the walk?

35. A garden is 24 yd. long and 16 yd. wide. What is its area in square yards?

36. The rug in the dining room is 16 ft. long and 12 ft. wide. Draw a plan of the rug on the scale of $\frac{1}{2}$ in. to 1 ft., and find the area of the rug.

OPTIONAL PROBLEMS

1. In emptying a 10-gallon can of milk into pint bottles 78 bottles were filled, the rest of the milk being lost. How much milk was lost?

2. At $1.85 a square yard, how much will it cost for linoleum to cover a hall 12 yd. by 15 yd.?

3. A strip of land for a school garden was laid out next to the school building. The strip was 34 ft. long and 2 ft. 6 in. wide, and a fence was put along the front and the two ends. At 7¢ a yard, how much did the fence cost?

In examples like this the pupils should first draw to scale a plan of the land, showing where the fence is to be placed.

4. Central Park is 4400 yd. long and 880 yd. wide. How many yards is it around the park? How many miles? At the rate of 1 mi. in 18 min., how long would it take a man to walk around the park?

5. On one wall of a schoolroom there is a space 12 ft. long and 18 in. high for the exhibition of drawings. If each drawing is 6 in. by 9 in., how many drawings can be placed in this space?

6. Mary measures a ruffle and finds it is 3 yd. 9 in. long. If there are 4 such ruffles to be edged with lace, how many yards of lace should Mary buy? How much will the lace cost at 25¢ a yard?

7. Fred makes a picture of a baseball diamond, each side being 9 in. If the real baseball diamond is 90 ft. on each side, what scale does Fred use?

8. Henry is making a bulletin board to be placed in a wall panel which is 5 ft. high and 3 ft. wide. If he must allow 8 in. between each edge of the board and the edge of the panel, what must be the dimensions of the bulletin board? Draw a plan.

9. A school building should allow 15 sq. ft. of floor space for every pupil in a room. If a room is 22 ft. by 24 ft., what is the greatest number of pupils that it could safely contain?

The pupils should measure their classroom and determine its capacity according to this standard. They should also learn to apply common sense to an answer involving a fraction, rejecting the fraction entirely in a case of this kind.

10. A builder wishes to cover the floor of a bathroom 10 ft. long and 7 ft. wide with tiles each 2 in. square. How many tiles must he order?

11. A blackboard in a schoolroom is 14 ft. long and 5 ft. high. If 5 boys are sent to the blackboard to work some examples, how many square feet does each boy have on an average?

Teachers may anticipate the work in canceling, if they wish, and thus make this example a very simple one.

12. In buying a peck of apples at \$1.20 a bushel, Mrs. Ford found that she got 46 apples, of which 4 were bad. She found that she could buy the same apples at 10¢ a dozen without taking any bad ones. Which plan was the better for her? If she wanted 42 apples, how much would she save by taking the better plan?

PROBLEMS WITHOUT NUMBERS

1. If you know the cost of each of two things, how do you find the cost of both together?

2. If you know the number of feet in a piece of string, and the length of a part of the string cut off, how do you find the length of what is left?

3. If you know the cost of one yard of cloth, how do you find the cost of a given number of yards?

4. If you have a certain number of inches of cloth of a certain width, and a book cover requires a certain number of inches of this width, how do you find the number of books you can cover with all the cloth?

5. If you know the number of quarts of milk in a can, how do you find the number of pints?

6. If you know the length of a piece of picture molding in feet, how do you find the length in inches?

7. If you have to multiply a number of two figures by a number of one figure, how do you proceed?

8. What do you mean by drawing a line to a given scale, say to the scale of 1 in. to 1 ft.?

9. How do you draw a rectangle to a given scale?

10. How do you find the area of a rectangle? Draw a rectangle to explain your answer.

11. Draw a plan of this page to some scale, and write below the drawing the scale you have used.

12. Draw a plan of the top of your desk to some scale, and write below the plan the scale you have used.

VIII. FRACTIONS

ORAL EXERCISE

1. Maud needs $\frac{1}{2}$ yd. of cloth for a doll's dress. She has a yard of cloth. How many dresses can she make from the cloth?

2. She has 2 yd. of another kind of cloth. How many dresses, of the kind stated in Ex. 1, can she make from it?

3. If Maud uses $\frac{1}{3}$ of a piece of cloth that is $1\frac{1}{2}$ yd. long, what part of a yard does she use? Draw a line on the blackboard to represent $1\frac{1}{2}$ yd., and mark off $\frac{1}{3}$ of it.

Teachers should recognize that the object of such a problem, as of this entire page, is to show the necessity for further work in fractions. It is not so important that the question should be answered promptly as to have the pupil feel that he must learn more about fractions. The problems furnish a motive for progress.

4. Maud's mother gives her a piece of cloth 16 in. long and tells her she can have half of it. Maud says that even 16 in. is not enough, but that she needs $1\frac{1}{2}$ times as much. How do you find how much Maud needs? Can you tell how much she needs?

5. Maud's mother tells her that she has a piece of cloth 30 in. long and can spare her all but 6 in. How much can Maud have? Is this as much as she needs according to Maud's suggestion in Ex. 4?

6. For trimming some dolls' clothes Maud has a piece of ribbon $5\frac{1}{2}$ in. long, and another piece of the same kind $5\frac{1}{4}$ in. long. Allowing a loss of $\frac{1}{4}$ in. for sewing the pieces together, how long a piece will these make?

ORAL EXERCISE

			4
		4	4
	4	4	4
4	4	4	4
4	8	12	16

			5
		5	5
	5	5	5
5	5	5	5
5	10	15	20

			6
		6	6
	6	6	6
6	6	6	6
6	12	18	24

			7
		7	7
	7	7	7
7	7	7	7
7	14	21	28

If we look at these columns and the sums, we see that 4 is $\frac{1}{2}$ of 8, 12 is $\frac{3}{4}$ of 16, and so on.

Point to the columns representing the following numbers, and tell the answers in all cases:

1. 10, $\frac{1}{2}$ of 10, $\frac{3}{2}$ of 10, $\frac{4}{2}$ of 10.
2. 15, $\frac{1}{3}$ of 15, $\frac{2}{3}$ of 15, $\frac{4}{3}$ of 15.
3. 14, $\frac{1}{2}$ of 14, $\frac{3}{2}$ of 14, $\frac{4}{2}$ of 14.
4. 21, $\frac{1}{3}$ of 21, $\frac{2}{3}$ of 21, $\frac{3}{3}$ of 21, $\frac{4}{3}$ of 21.
5. 28, $\frac{1}{4}$ of 28, $\frac{2}{4}$ (or $\frac{1}{2}$) of 28, $\frac{3}{4}$ of 28.
6. 12, $\frac{1}{3}$ of 12, $\frac{2}{3}$ of 12, $\frac{1}{2}$ of 12, $\frac{3}{2}$ of 12.
7. 18, $1\frac{1}{3}$ times 18, $\frac{1}{3}$ of 18, $\frac{2}{3}$ of 18, $\frac{4}{3}$ of 18.
8. Think of $\frac{1}{3}$ of each of the following numbers, and then state $\frac{2}{3}$ of each:

9 6 12 3 21 30 33 36

9. Think of $\frac{1}{4}$ of each of the following numbers, and then state $\frac{3}{4}$ of each:

32 40 12 24 20 28 36 44

ORAL EXERCISE

State the values of:

1. $\frac{1}{2}$ doz. $\frac{1}{4}$ doz. $\frac{1}{3}$ doz. $\frac{1}{6}$ doz. $\frac{1}{12}$ doz.
2. $\frac{3}{4}$ doz. $\frac{2}{3}$ doz. $\frac{5}{6}$ doz. $\frac{5}{12}$ doz. $\frac{7}{12}$ doz.
3. There being 36 in. in 1 yd., state the values of:
   $\frac{1}{6}$ yd. $\frac{1}{3}$ yd. $\frac{1}{4}$ yd. $\frac{1}{9}$ yd. $\frac{1}{2}$ yd.

State the values of:

4. $\frac{1}{2}$ of 4 $\frac{1}{2}$ of 10 $\frac{1}{2}$ of 12 $\frac{1}{2}$ of 20 $\frac{1}{2}$ of 16
5. $\frac{1}{4}$ of 4 $\frac{1}{4}$ of 12 $\frac{1}{4}$ of 16 $\frac{1}{4}$ of 24 $\frac{1}{4}$ of 36
6. $\frac{1}{5}$ of 5 $\frac{1}{5}$ of 20 $\frac{1}{5}$ of 15 $\frac{1}{5}$ of 30 $\frac{1}{5}$ of 50
7. $\frac{1}{3}$ of 6 $\frac{1}{3}$ of 15 $\frac{1}{3}$ of 21 $\frac{1}{6}$ of 12 $\frac{1}{6}$ of 18
8. $\frac{1}{8}$ of 8 $\frac{1}{8}$ of 16 $\frac{1}{8}$ of 32 $\frac{1}{8}$ of 40 $\frac{1}{8}$ of 80

WRITTEN EXERCISE

Write the values of:

1. $\frac{1}{3}$ of 18 $\frac{2}{3}$ of 18 $\frac{1}{3}$ of 21 $\frac{2}{3}$ of 21 $\frac{2}{3}$ of 30
2. $\frac{1}{4}$ of 16 $\frac{3}{4}$ of 16 $\frac{1}{4}$ of 32 $\frac{3}{4}$ of 32 $\frac{3}{4}$ of 40
3. $\frac{1}{5}$ of 25 $\frac{2}{5}$ of 25 $\frac{3}{5}$ of 25 $\frac{3}{5}$ of 50 $\frac{4}{5}$ of 50
4. $\frac{1}{6}$ of 12 $\frac{5}{6}$ of 12 $\frac{1}{6}$ of 18 $\frac{5}{6}$ of 18 $\frac{1}{6}$ of 60
5. $\frac{1}{8}$ of 24 $\frac{3}{8}$ of 24 $\frac{5}{8}$ of 24 $\frac{1}{8}$ of 80 $\frac{5}{8}$ of 80

6. We know that 2 is $\frac{1}{3}$ of 6, that 3 is $\frac{1}{3}$ of 9, and so on. Write five similar examples.

7. As in Ex. 6, write five numbers each equal to

$\frac{1}{4}$ of some other number $\frac{1}{5}$ of some other number
$\frac{3}{4}$ of some other number $\frac{2}{5}$ of some other number

Terms of a Fraction. To take $\frac{3}{8}$ of this rectangle, we divide the rectangle into 8 equal parts and take 3 of these equal parts.

In the fraction $\frac{3}{8}$, the number 8 is called the *denominator*, and it tells the number of equal parts into which the unit, in this case the rectangle, has been divided.

In the same fraction, the number 3 is called the *numerator*, and it tells how many equal parts are taken.

$$\frac{3 = \text{numerator}}{8 = \text{denominator}}$$

The numerator and denominator are called the *terms* of the fraction. The terms of the fraction $\frac{3}{8}$ are 3 and 8.

A whole number, like 1, 2, 7, 2500, or \$10, is called an *integer*.

An integer and a fraction taken together, like $2\frac{1}{2}$ or $4\frac{3}{4}$ ft., is called a *mixed number*.

A fraction that is less than 1, like $\frac{1}{2}$, $\frac{3}{4}$, or $\frac{2}{5}$, is called a *proper fraction*.

A fraction that is equal to 1, like $\frac{4}{4}$ or $\frac{5}{5}$, or greater than 1, like $\frac{5}{4}$ or $\frac{15}{8}$, is called an *improper fraction*.

We see that we can write improper fractions as whole numbers or as mixed numbers. For example,

$$\frac{4}{4} = 1 \quad \frac{5}{4} = 1\frac{1}{4} \quad \frac{5}{5} = 1 \quad \frac{8}{5} = 1\frac{3}{5} \quad \frac{6}{6} = 1 \quad \frac{11}{6} = 1\frac{5}{6}$$

The New York City course of study does not require the definitions given on this page, but it requires the recognition of the terms "numerator" and "denominator" at this time. The other terms explained above are mentioned in the syllabus, however, and their meaning should be understood by the pupils.

ORAL EXERCISE

1. In the fraction $\frac{7}{8}$, which number is the denominator? What does it tell about the fraction? Which is the numerator, and what does it tell about the fraction?

2. State the integers in this list: $\frac{2}{3}$, 4, $3\frac{7}{8}$, 1, $7\frac{1}{2}$, 12.

3. State the mixed numbers in this list: $\frac{4}{2}$, $3\frac{1}{2}$, $2\frac{2}{3}$, 9.

4. State the proper fractions in this list: $\frac{4}{2}$, $\frac{1}{2}$, $\frac{3}{2}$, $\frac{7}{8}$.

5. State the improper fractions in this list: $\frac{5}{4}$, $\frac{7}{7}$, $\frac{2}{3}$, $\frac{8}{5}$.

6. Find $\frac{2}{3}$ of 6; of 9; of 27; of 30; of 60.

7. A grocer had a box of 150 apples and sold $\frac{2}{3}$ of them. How many apples did he sell?

8. Find $\frac{3}{4}$ of 8; of 12; of 24; of 32; of 88.

9. A fruit dealer had a box of 120 grapefruits and sold $\frac{3}{4}$ of them. How many did he sell and how many did he have left?

10. If you pay 32¢ for 1 lb. of butter, how much will you pay for $\frac{1}{4}$ lb.? How much will you pay for $\frac{3}{4}$ lb.? How much will you pay for $1\frac{1}{4}$ lb.?

11. Find $\frac{4}{5}$ of 10; of 20; of 35; of 45; of 50; of 60.

12. Find $\frac{5}{6}$ of 12; of 18; of 30; of 42; of 60; of 120.

13. Find $\frac{3}{8}$ of 16; of 24; of 40; of 56; of 80; of 96.

14. Find $\frac{2}{7}$ of 14; $\frac{4}{9}$ of 27; $\frac{7}{9}$ of 81; $\frac{3}{11}$ of 22.

15. Find $\frac{3}{10}$ of 20; of 40; of 70; of 90; of 110; of 120.

16. Find $\frac{1}{12}$ of 60; $\frac{5}{12}$ of 72; $\frac{7}{12}$ of 96; $\frac{11}{12}$ of 144.

It should be borne in mind that the fractions which the pupils will actually meet in business rarely have other denominators than 2, 3, 4, 8, and 12, and very rarely one greater than 16.

WRITTEN EXERCISE

1. How do you find $\frac{2}{3}$ of a number? How do you find $\frac{2}{3}$ of 150? $\frac{2}{3}$ of 75? $\frac{2}{3}$ of 300?

2. Frank has 65 marbles and Rob has $\frac{3}{5}$ as many. How many marbles has Rob?

3. If 45 drops of water make a teaspoonful, how many drops of water make $\frac{2}{5}$ of a teaspoonful?

4. Mary uses 10 yd. of cloth in making a dress, and Kate uses $\frac{4}{5}$ as much. How much does Kate use?

5. Fred has a kite string that is 336 ft. long, and Will has one that is $\frac{7}{8}$ as long. How long is Will's?

6. A man has \$720 in the bank and draws out $\frac{5}{8}$ of it. How much does he draw out? How much is left?

Find the following parts of the numbers given:

7. $\frac{1}{3}$ of 126, $\frac{2}{3}$ of 126.
8. $\frac{1}{3}$ of 330, $\frac{2}{3}$ of 330.
9. $\frac{1}{3}$ of 450, $\frac{2}{3}$ of 450.
10. $\frac{1}{3}$ of 510, $\frac{2}{3}$ of 510.
11. $\frac{1}{3}$ of 639, $\frac{2}{3}$ of 639.
12. $\frac{1}{3}$ of 723, $\frac{2}{3}$ of 723.
13. $\frac{1}{4}$ of 128, $\frac{3}{4}$ of 128.
14. $\frac{1}{4}$ of 224, $\frac{3}{4}$ of 224.
15. $\frac{1}{4}$ of 328, $\frac{3}{4}$ of 328.
16. $\frac{1}{4}$ of 344, $\frac{3}{4}$ of 344.
17. $\frac{1}{4}$ of 524, $\frac{3}{4}$ of 524.
18. $\frac{1}{4}$ of 672, $\frac{3}{4}$ of 672.
19. $\frac{1}{5}$ of 225, $\frac{2}{5}$ of 225.
20. $\frac{3}{5}$ of 225, $\frac{4}{5}$ of 225.
21. $\frac{1}{5}$ of 335, $\frac{4}{5}$ of 335.
22. $\frac{2}{5}$ of 725, $\frac{3}{5}$ of 865.
23. $\frac{1}{6}$ of 336, $\frac{5}{6}$ of 336.
24. $\frac{1}{6}$ of 726, $\frac{5}{6}$ of 726.
25. $\frac{1}{8}$ of 328, $\frac{3}{8}$ of 328.
26. $\frac{5}{8}$ of 328, $\frac{7}{8}$ of 328.
27. $\frac{3}{8}$ of 488, $\frac{5}{8}$ of 488.
28. $\frac{1}{7}$ of 147, $\frac{2}{7}$ of 847.
29. $\frac{3}{7}$ of 287, $\frac{4}{7}$ of 294.
30. $\frac{4}{9}$ of 810, $\frac{5}{9}$ of 720.

Multiplying by a Mixed Number. If 1 lb. of butter costs 32¢, how much will $2\frac{1}{4}$ lb. cost?

We see that $2\frac{1}{4}$ lb. will cost $2\frac{1}{4} \times 32¢$.

We multiply 32 by $2\frac{1}{4}$ like this:

$\frac{1}{4}$ of $32 = 8$, and we write the 8 below the line under the 2.

$2 \times 32 = 64$, and we write the 64 below the 8 with the 4 under the 8.

$64 + 8 = 72$, and therefore the answer is 72¢.

$$\begin{array}{r} 32 \\ 2\frac{1}{4} \\ \hline 8 \\ 64 \\ \hline 72 \end{array}$$

ORAL EXERCISE

1. At 36¢ a pound, how much will $1\frac{1}{4}$ lb. of butter cost?
2. If 1 doz. eggs cost 40¢, how much will $1\frac{1}{4}$ doz. cost?

Multiply the following:

3. $1\frac{1}{2} \times 4$.
4. $1\frac{1}{2} \times 8$.
5. $1\frac{1}{2} \times 6$.
6. $2\frac{1}{2} \times 4$.
7. $2\frac{1}{2} \times 6$.
8. $2\frac{1}{2} \times 2$.
9. $1\frac{1}{4} \times 8$.
10. $1\frac{1}{3} \times 9$.

WRITTEN EXERCISE

1. If 1 doz. eggs cost 48¢, how much will $\frac{3}{4}$ doz. cost?
2. If 1 yd. of silk costs 84¢, how much will $3\frac{1}{4}$ yd. cost?

Multiply the following:

3. $1\frac{1}{2} \times 16$.
4. $1\frac{1}{2} \times 20$.
5. $1\frac{1}{2} \times 36$.
6. $2\frac{1}{2} \times 36$.
7. $4\frac{1}{2} \times 48$.
8. $1\frac{1}{2} \times 96$.
9. $1\frac{1}{3} \times 96$.
10. $1\frac{1}{4} \times 96$.
11. $1\frac{1}{8} \times 96$.
12. $2\frac{1}{8} \times 96$.
13. $1\frac{1}{3} \times 39$.
14. $2\frac{1}{3} \times 39$.
15. $5\frac{1}{3} \times 39$.
16. $1\frac{1}{4} \times 72$.
17. $2\frac{1}{4} \times 72$.
18. $1\frac{1}{5} \times 35$.
19. $3\frac{1}{5} \times 35$.
20. $5\frac{1}{5} \times 75$.
21. $3\frac{1}{8} \times 48$.
22. $5\frac{1}{8} \times 48$.

ORAL EXERCISE

1. How many halves of an apple in 1 apple?

2. How many halves of an apple in 2 apples? in $2\frac{1}{2}$ apples? in $3\frac{1}{2}$ apples?

3. How many whole apples in $\frac{2}{2}$ apples? in $\frac{6}{2}$ apples? in $\frac{4}{2}$ apples? in $\frac{10}{2}$ apples?

4. How many inches are $1\frac{1}{2}$ in. $+ \frac{1}{2}$ in.? $1\frac{1}{2}$ in. $+ 1\frac{1}{2}$ in.? $3\frac{1}{2}$ in. $+ \frac{1}{2}$ in.? $3\frac{1}{2}$ in. $+ 2\frac{1}{2}$ in.?

5. If Harriet needs $2\frac{1}{2}$ yd. of cloth for some sewing, and has $3\frac{1}{2}$ yd., how much has she to spare?

State the results:

6. $3\frac{1}{2} + \frac{1}{2}$. **8.** $4\frac{1}{2} + 2\frac{1}{2}$. **10.** $9\frac{1}{2} - 3$. **12.** $8\frac{1}{2} + 4\frac{1}{2}$.

7. $3\frac{1}{2} + 3\frac{1}{2}$. **9.** $7\frac{1}{2} - \frac{1}{2}$. **11.** $6\frac{1}{2} - 3\frac{1}{2}$. **13.** $8\frac{1}{2} - 4\frac{1}{2}$.

14. Look at the blocks in this picture. *D* is what part as large as *C*? *D* is what part as large as *B*? *D* is what part as large as *A*? *C* is what part as large as *B*?

ORAL EXERCISE

1. Look at figure *A* and state how many sixths you see in one half.

2. Look at figure *B* and state how many eighths you see in one half; in three quarters.

3. How many tenths do you see in $\frac{1}{2}$? in $\frac{1}{5}$? in $\frac{4}{5}$?

Reduction. We see that $\frac{2}{4}$ can be obtained from $\frac{1}{2}$ by multiplying both terms by 2, and that $\frac{1}{2}$ can be obtained from $\frac{4}{8}$ by dividing both terms by 4. That is,

Both terms of a fraction may be multiplied by the same number without changing the value of the fraction.

Both terms of a fraction may be divided by the same number without changing the value of the fraction.

When we change the value of the terms without changing the value of a fraction we *reduce* the fraction.

When both terms cannot be divided by the same number, the fraction is said to be *in lowest terms*.

To reduce a fraction to lowest terms, divide by the largest number that will divide both terms without a remainder.

$$\frac{8}{12} = \frac{8 \div 4}{12 \div 4} = \frac{2}{3}, \text{ lowest terms.}$$

In this example, 4 is said to be *canceled* from both terms when the work is written in the form shown in the margin. We write all fractions in lowest terms unless otherwise directed.

$$\frac{\overset{2}{\cancel{8}}}{\underset{3}{\cancel{12}}} = \frac{2}{3}$$

WRITTEN EXERCISE

1. Reduce the following fractions to halves:

$\frac{2}{4}$ $\frac{4}{8}$ $\frac{8}{8}$ $\frac{12}{8}$ $\frac{16}{8}$ $\frac{24}{8}$ $\frac{32}{8}$ $\frac{40}{8}$

2. Reduce the following fractions to fourths:

$\frac{1}{2}$ $\frac{2}{8}$ $\frac{4}{8}$ $\frac{16}{8}$ $\frac{10}{8}$ $\frac{20}{8}$ $\frac{18}{8}$ $\frac{22}{8}$

3. Reduce the following fractions to eighths:

$\frac{1}{2}$ $\frac{1}{4}$ $\frac{3}{4}$ $\frac{4}{4}$ $\frac{6}{4}$ $\frac{7}{2}$ $\frac{2}{16}$ $\frac{4}{16}$

4. Reduce the following fractions to twelfths:

$\frac{1}{2}$ $\frac{1}{4}$ $\frac{3}{4}$ $\frac{1}{3}$ $\frac{2}{3}$ $\frac{1}{6}$ $\frac{5}{6}$ $\frac{2}{24}$

5. Reduce the following fractions to lowest terms:

$\frac{2}{4}$ $\frac{4}{8}$ $\frac{2}{8}$ $\frac{8}{10}$ $\frac{3}{6}$ $\frac{4}{6}$ $\frac{6}{8}$ $\frac{5}{10}$

6. Express $\frac{1}{3}$ in. and $\frac{1}{2}$ in. as sixths of an inch, and tell which is the greater.

7. Express $\frac{1}{3}$ in. and $\frac{1}{4}$ in. as twelfths of an inch, and tell which is the greater.

8. Express as sixths: $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{2}{3}$.

9. Express as tenths: $\frac{1}{2}$, $\frac{1}{5}$, $\frac{3}{5}$, $\frac{2}{5}$, and $\frac{4}{5}$.

10. Express as fifteenths: $\frac{1}{3}$, $\frac{1}{5}$, $\frac{2}{5}$, $\frac{4}{5}$, $\frac{2}{3}$, and $\frac{3}{5}$.

11. Express as sixteenths: $\frac{1}{2}$, $\frac{1}{4}$, $\frac{7}{8}$, $\frac{3}{4}$, $\frac{3}{8}$, and $\frac{5}{8}$.

12. Express $\frac{4}{8}$ as halves; as fourths; as sixteenths.

13. Reduce $\frac{8}{8}$ to halves; to fourths; to sixteenths.

14. How many fourths in $\frac{2}{4}$? in $\frac{1}{2}$? in $\frac{2}{2}$?

15. How many eighths in $\frac{4}{8}$? in $\frac{1}{2}$? in 1?

16. How many tenths in $\frac{5}{10}$? in $\frac{1}{2}$? in 1? in 2?

17. How many twelfths in $\frac{6}{12}$? in $\frac{1}{2}$? in 1? in 3?

Cancellation. A room 15 ft. by 18 ft. and an entrance hall 3 ft. by 9 ft. are both to have new ceilings. The area of the first ceiling is how many times that of the second ceiling?

We see that we may find the two areas, and then divide the first by the second.

There is a shorter way, however. We may write 15×18 as the numerator of a fraction, and 3×9 as the denominator, and then cancel as here shown.

$$\frac{\overset{5}{\cancel{15}} \times \overset{2}{\cancel{18}}}{\underset{1}{\cancel{3}} \times \underset{3}{\cancel{9}}} = 10$$

The answer is 10, and so the area of the first ceiling is 10 times that of the second.

WRITTEN EXERCISE

Find the value of each of the following:

1. $\frac{18}{9}$.	4. $\frac{56}{8}$.	7. $\frac{96}{16}$.	10. $\frac{144}{24}$.	13. $\frac{200}{50}$.
2. $\frac{45}{5}$.	5. $\frac{72}{9}$.	8. $\frac{144}{12}$.	11. $\frac{175}{25}$.	14. $\frac{150}{75}$.
3. $\frac{45}{9}$.	6. $\frac{96}{6}$.	9. $\frac{156}{12}$.	12. $\frac{200}{25}$.	15. $\frac{240}{40}$.

Find the value of each of the following:

16. $\frac{18 \times 5}{9}$.	19. $\frac{18 \times 15}{5}$.	22. $\frac{15 \times 21}{5 \times 7}$.	25. $\frac{15 \times 33}{5 \times 11}$.
17. $\frac{27 \times 5}{9}$.	20. $\frac{18 \times 21}{7}$.	23. $\frac{21 \times 24}{7 \times 8}$.	26. $\frac{21 \times 33}{7 \times 11}$.
18. $\frac{18 \times 15}{9}$.	21. $\frac{18 \times 21}{9 \times 7}$.	24. $\frac{16 \times 21}{4 \times 3}$.	27. $\frac{24 \times 35}{8 \times 7}$.

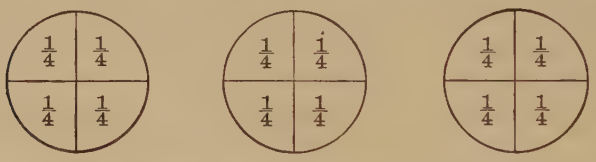
Reduction of an Improper Fraction to a Mixed Number. If you have $\frac{3}{4}$ yd. of ribbon and buy $\frac{3}{4}$ yd. more, how much ribbon will you have?

Just as $3¢ + 3¢ = 6¢$,

so $\frac{3}{4} + \frac{3}{4} = \frac{6}{4}$,

and so you will have $\frac{6}{4}$ yd. of ribbon.

But how many yards are there in $\frac{6}{4}$ yd. of ribbon?



Let us first see how many circles can be made from $\frac{6}{4}$ of a circle. How many circles can be made from $\frac{12}{4}$ of a circle? from $\frac{8}{4}$? from $\frac{4}{4}$? Then how many halves of a circle in $\frac{2}{4}$ of the circle? Then $\frac{6}{4}$ of a circle is equal to 1 circle and what part of the circle?

In the same way, $\frac{3}{4}$ yd. + $\frac{3}{4}$ yd. = $\frac{6}{4}$ yd. = $1\frac{2}{4}$ yd. = $1\frac{1}{2}$ yd.

To reduce a fraction to a whole or a mixed number divide the numerator by the denominator

WRITTEN EXERCISE

Reduce the following to whole or mixed numbers:

1. $\frac{4}{2}$.	5. $\frac{5}{2}$.	9. $\frac{4}{3}$.	13. $\frac{5}{4}$.	17. $\frac{15}{5}$.
2. $\frac{6}{2}$.	6. $\frac{3}{3}$.	10. $\frac{7}{3}$.	14. $\frac{7}{4}$.	18. $\frac{16}{8}$.
3. $\frac{8}{2}$.	7. $\frac{6}{3}$.	11. $\frac{8}{4}$.	15. $\frac{5}{5}$.	19. $\frac{20}{4}$.
4. $\frac{3}{2}$.	8. $\frac{9}{3}$.	12. $\frac{9}{4}$.	16. $\frac{9}{8}$.	20. $\frac{12}{8}$.

Adding Fractions. If Kate buys two remnants of ribbon, one being $4\frac{2}{3}$ yd. long and the other $2\frac{2}{3}$ yd. long, how many yards of ribbon does she buy?

We see that we must add $4\frac{2}{3}$ yd. and $2\frac{2}{3}$ yd.

We first add the thirds, thus:

$$\frac{2}{3} + \frac{2}{3} = \frac{4}{3} = 1\frac{1}{3}.$$

$$\begin{array}{r} 4\frac{2}{3} \\ 2\frac{2}{3} \\ \hline 7\frac{1}{3} \end{array}$$

We write the $\frac{1}{3}$ in the fractions' column and add the 1 to the ones' column. Then $1 + 2 + 4 = 7$, and we write the 7 in the ones' column.

The sum is $7\frac{1}{3}$, and so Kate buys $7\frac{1}{3}$ yd. of ribbon.

WRITTEN EXERCISE

1. Nora has three pieces of ribbon. The first is $2\frac{1}{3}$ yd. long, the second $1\frac{1}{3}$ yd. long, and the third $4\frac{1}{3}$ yd. long. How many yards has she in all?

2. Fred is making a picture frame that is $9\frac{1}{2}$ in. high and $7\frac{1}{2}$ in. wide. How many inches of molding does he need?

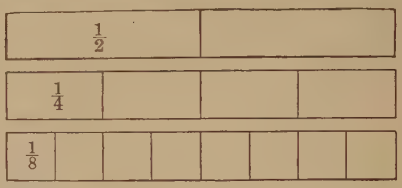
Add the following:

3.	4.	5.	6.	7.	8.
$3\frac{1}{2}$	$2\frac{1}{2}$	$24\frac{1}{3}$	$12\frac{2}{3}$	$16\frac{2}{3}$	$28\frac{1}{3}$
$2\frac{1}{2}$	$4\frac{1}{2}$	$16\frac{1}{3}$	$3\frac{2}{3}$	$14\frac{2}{3}$	$14\frac{2}{3}$
4	$6\frac{1}{2}$	$17\frac{2}{3}$	$4\frac{2}{3}$	$15\frac{2}{3}$	$15\frac{2}{3}$

9.	10.	11.	12.	13.	14.
$2\frac{1}{3}$	$1\frac{1}{2}$	$62\frac{1}{2}$	$39\frac{1}{2}$	$37\frac{1}{3}$	$57\frac{1}{3}$
$3\frac{1}{3}$	7	$17\frac{1}{2}$	$12\frac{1}{2}$	$29\frac{1}{3}$	$22\frac{2}{3}$
2	$3\frac{1}{2}$	12	$33\frac{1}{2}$	16	$33\frac{2}{3}$

ORAL EXERCISE

1. Calling the large rectangle *one*, how many halves do you see in 1?



2. How many fourths do you see in 1? in $\frac{1}{2}$?

3. How many eighths do you see in 1? in $\frac{1}{2}$? in $\frac{1}{4}$?

4. How many sixths of the line do you see in $\frac{1}{2}$ of a line?

5. $1\frac{1}{2}$ = how many sixths?

6. How many sixths do you see in $\frac{1}{3}$? in $\frac{2}{3}$? in $\frac{3}{3}$?

7. If we have a piece of ribbon $\frac{1}{2}$ yd. long and another piece $\frac{1}{4}$ yd. long, have we enough ribbon for trimming a doll's dress that needs a piece $\frac{3}{4}$ yd. long?

We see by the rectangles above that $\frac{1}{2} = \frac{2}{4}$, and so $\frac{1}{2} + \frac{1}{4} = \frac{2}{4} + \frac{1}{4}$.

But just as $2¢ + 1¢ = 3¢$, so $\frac{2}{4} + \frac{1}{4} = \frac{3}{4}$.

So the sum of $\frac{1}{2}$ and $\frac{1}{4}$ is $\frac{3}{4}$, and we have enough trimming for the doll's dress.

$$\frac{1}{2} = \frac{2}{4}$$
$$\frac{1}{4} = \frac{1}{4}$$
$$\frac{3}{4}$$

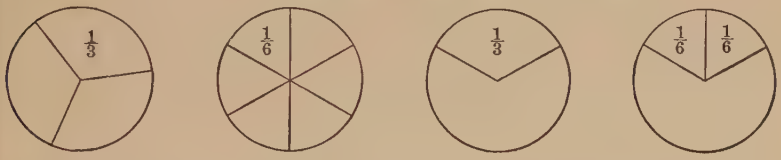
In these simple examples for beginners we need not consider the question of loss in sewing the two pieces together.

Looking at the above figures, add or subtract as stated:

8.	9.	10.	11.	12.
$\frac{1}{2} + \frac{1}{4}$	$\frac{1}{4} + \frac{1}{8}$	$\frac{5}{8} - \frac{1}{4}$	$\frac{1}{2} + \frac{1}{8}$	$1 - \frac{1}{8}$
$\frac{1}{2} - \frac{1}{4}$	$\frac{1}{4} - \frac{1}{8}$	$\frac{7}{8} - \frac{1}{4}$	$\frac{1}{2} - \frac{1}{8}$	$1 - \frac{1}{4}$
$\frac{3}{4} - \frac{1}{2}$	$\frac{3}{4} + \frac{1}{8}$	$\frac{7}{8} - \frac{3}{4}$	$\frac{1}{2} - \frac{3}{8}$	$1 - \frac{1}{6}$
$\frac{3}{4} + \frac{1}{2}$	$\frac{3}{4} - \frac{1}{8}$	$\frac{3}{4} - \frac{5}{8}$	$\frac{5}{8} - \frac{1}{2}$	$1 - \frac{1}{3}$

ORAL EXERCISE

1. If we divide a circle into thirds and cut each third into halves, into how many equal parts is the whole circle divided? What is each of these equal parts called? How many sixths of a circle are there in 1 circle?



2. Mary gave $\frac{1}{6}$ of a pie to Julia, $\frac{1}{6}$ to Ruth, and $\frac{1}{6}$ to John. What part of the pie did she give away?

3. John's mother gave him $\frac{1}{3}$ of a pie and he gave $\frac{1}{2}$ of his piece to Ray. What part of the pie did Ray receive?

4. Show $\frac{1}{3}$ of this oblong; $\frac{1}{6}$ of it. Then $\frac{1}{6}$ is what part of $\frac{1}{3}$? $\frac{1}{3}$ is how many sixths? $\frac{1}{2}$ is how many sixths? Then $\frac{1}{2}+\frac{1}{6}$ is how many sixths? $\frac{1}{3}+\frac{1}{6}$ is how many sixths? $\frac{1}{2}+\frac{1}{3}$ is how many sixths?

Further Work in Adding Fractions. From the above exercise we see that we may add $2\frac{1}{2}$ and $3\frac{3}{4}$ like this:

To add $\frac{1}{2}$ to $\frac{3}{4}$ we think of $\frac{1}{2}$ as $\frac{2}{4}$. We then add the fractions $\frac{2}{4}$ and $\frac{3}{4}$, and obtain as the sum $\frac{5}{4}$, or $1\frac{1}{4}$. Then we add the 1 to the sum of 2 and 3, obtaining 6. So the sum of $2\frac{1}{2}$ and $3\frac{3}{4}$ is $6\frac{1}{4}$.

$$2\tfrac{1}{2} = 2\tfrac{2}{4}$$
$$3\tfrac{3}{4} = 3\tfrac{3}{4}$$
$$5\tfrac{5}{4} = 6\tfrac{1}{4}$$

ORAL EXERCISE

1. Express $\frac{1}{2}$ as eighths. To the result add $\frac{3}{8}$.

2. If you are making a bird house and fasten a strip of molding $\frac{3}{8}$ in. thick to a strip of wood $\frac{1}{2}$ in. thick, how thick are the two together?

3. Express $\frac{3}{4}$ as eighths. To the result add $\frac{7}{8}$.

4. If we sew together insertion $\frac{3}{4}$ in. wide and lace $\frac{7}{8}$ in. wide, how wide are the two?

5. Express $\frac{1}{2}$ as eighths. To the result add $\frac{7}{8}$.

6. If you lay a notebook $\frac{1}{2}$ in. thick on a book $\frac{7}{8}$ in. thick, how thick are the two together?

7. How do you add one fraction to another?

WRITTEN EXERCISE

Add the following:

1. $\frac{1}{2} + \frac{1}{2}$.
2. $\frac{1}{3} + \frac{1}{3} + \frac{1}{3}$.
3. $\frac{1}{4} + \frac{1}{4} + \frac{1}{4}$.
4. $\frac{1}{5} + \frac{1}{5} + \frac{2}{5}$.
5. $\frac{1}{4} + \frac{1}{4} + \frac{2}{4}$.
6. $\frac{1}{6} + \frac{1}{6} + \frac{5}{6}$.
7. $\frac{1}{10} + \frac{3}{10}$.
8. $\frac{1}{8} + \frac{1}{8} + \frac{3}{8}$.
9. $\frac{1}{8} + \frac{5}{8} + \frac{3}{8}$.
10. $\frac{3}{10} + \frac{7}{10}$.
11. $\frac{1}{12} + \frac{5}{12} + \frac{5}{12}$.
12. $\frac{3}{16} + \frac{3}{16} + \frac{7}{16}$.
13. $\frac{3}{16} + \frac{5}{16} + \frac{7}{16}$.
14. $\frac{1}{16} + \frac{3}{16} + \frac{5}{16}$.
15. $\frac{5}{16} + \frac{5}{16} + \frac{7}{16}$.

Add, as on pages 144 and 145:

16. $\frac{1}{2} + \frac{1}{4}$.
17. $\frac{1}{2} + \frac{3}{4}$.
18. $\frac{1}{2} + \frac{1}{8}$.
19. $\frac{1}{2} + \frac{3}{8}$.
20. $\frac{1}{2} + \frac{5}{8}$.
21. $\frac{1}{2} + \frac{7}{8}$.
22. $\frac{1}{4} + \frac{1}{8}$.
23. $\frac{1}{4} + \frac{3}{8}$.
24. $\frac{1}{4} + \frac{5}{8}$.
25. $\frac{1}{4} + \frac{7}{8}$.
26. $\frac{3}{4} + \frac{5}{8}$.
27. $\frac{3}{4} + \frac{7}{8}$.
28. $1\frac{1}{2} + \frac{1}{2}$.
29. $2\frac{1}{2} + \frac{1}{4}$.
30. $7\frac{1}{2} + 3\frac{1}{2}$.
31. $5\frac{1}{4} + 2\frac{3}{4}$.

The results should be given in lowest terms.

WRITTEN EXERCISE

1. If we have $2\frac{1}{2}$ yd. of cloth in one piece and $1\frac{1}{2}$ yd. in another, how much have we in both?

2. If we buy $1\frac{1}{4}$ yd. of one kind of ribbon and $\frac{3}{4}$ yd. of another kind, how much do we buy in all?

Add the following:

3. $3\frac{1}{4} + \frac{1}{4}$.
4. $3\frac{3}{4} + 2\frac{3}{4}$.
5. $2\frac{1}{2} + \frac{1}{2}$.
6. $3\frac{1}{8} + 2\frac{7}{8}$.
7. $4\frac{2}{5} + 6\frac{3}{5}$.
8. $3\frac{1}{4} + \frac{3}{4}$.
9. $7\frac{3}{4} + 9\frac{3}{4}$.
10. $2\frac{1}{2} + 3\frac{1}{2}$.
11. $3\frac{3}{8} + 2\frac{7}{8}$.
12. $3\frac{3}{4} + 5\frac{1}{4}$.
13. $3\frac{3}{4} + \frac{3}{4}$.
14. $6\frac{3}{4} + 7\frac{3}{4}$.
15. $3\frac{1}{8} + 2\frac{5}{8}$.
16. $9\frac{5}{8} + 6\frac{7}{8}$.
17. $4\frac{3}{8} + 6\frac{3}{8}$.

18. If a desk is $2\frac{1}{4}$ ft. long and $1\frac{1}{8}$ ft. wide, what is the sum of the length and width of the desk?

Add the following:

19. $2\frac{1}{2} + 1\frac{1}{8}$.
20. $3\frac{1}{2} + 5\frac{1}{8}$.
21. $8\frac{3}{4} + 5$.
22. $4\frac{3}{8} + 6\frac{5}{16}$.
23. $9\frac{3}{5} + 2\frac{2}{3}$.
24. $5\frac{7}{8} + 2\frac{5}{16}$.
25. $2\frac{1}{4} + 1\frac{1}{8}$.
26. $4\frac{1}{2} + 6\frac{1}{8}$.
27. $6\frac{3}{4} + 8\frac{1}{8}$.
28. $7\frac{3}{4} + 2\frac{3}{8}$.
29. $6\frac{1}{8} + 5\frac{3}{4}$.
30. $3\frac{2}{3} + 8\frac{1}{3}$.
31. $4\frac{1}{4} + 1\frac{1}{8}$.
32. $5\frac{1}{4} + 7\frac{1}{2}$.
33. $3\frac{3}{4} + 5\frac{5}{8}$.
34. $6\frac{3}{4} + 7\frac{1}{2}$.
35. $7\frac{7}{8} + 1\frac{3}{4}$.
36. $2\frac{3}{4} + 5\frac{3}{8}$.

37. If you place a board $\frac{5}{8}$ in. thick on a plank that is $1\frac{3}{4}$ in. thick, what is the total thickness?

38. If you place a plank $1\frac{7}{8}$ in. thick on a beam that is $8\frac{3}{4}$ in. thick, what is the total thickness?

39. Add $1\frac{1}{2}$ in., $1\frac{1}{2}$ in., $2\frac{1}{2}$ in., and $3\frac{1}{4}$ in.

Subtracting Fractions. Sue has 12 yd. of cloth. She uses $2\frac{2}{3}$ yd. for a doll's suit. How many yards has she left?

We must subtract $2\frac{2}{3}$ yd. from 12 yd.

We cannot take $\frac{2}{3}$ from nothing, so we think of 12 as $11\frac{3}{3}$, which we can do because $\frac{3}{3} = 1$.

We see that $\frac{3}{3} - \frac{2}{3} = \frac{1}{3}$, and we write the $\frac{1}{3}$ in the fractions' column. Then $11 - 2 = 9$, and we write the 9 in the ones' column.

$$\begin{array}{r} 12 \\ 2\frac{2}{3} \\ \hline 9\frac{1}{3} \end{array}$$

The difference is $9\frac{1}{3}$, and so Sue has $9\frac{1}{3}$ yd. left.

WRITTEN EXERCISE

1. If you have a piece of paper $12\frac{1}{3}$ in. long, and cut off a piece $3\frac{2}{3}$ in. long, how long is the piece that is left?

Why does $12\frac{1}{3} - 3\frac{2}{3}$ have the same result as $11\frac{4}{3} - 3\frac{2}{3}$?

2. If James saws a piece of board $8\frac{1}{2}$ in. long from a piece 24 in. long, how long is the piece that is left?

Subtract the following:

3.	**4.**	**5.**	**6.**	**7.**	**8.**
8	6	9	7	18	36
$2\frac{1}{2}$	$3\frac{1}{2}$	$2\frac{1}{3}$	$2\frac{2}{3}$	$5\frac{1}{4}$	$18\frac{3}{4}$
9.	**10.**	**11.**	**12.**	**13.**	**14.**
$7\frac{1}{2}$	$6\frac{1}{3}$	$9\frac{1}{3}$	$8\frac{1}{3}$	$16\frac{1}{3}$	$48\frac{1}{3}$
$4\frac{1}{2}$	$2\frac{1}{3}$	$2\frac{2}{3}$	$3\frac{2}{3}$	$8\frac{2}{3}$	$36\frac{2}{3}$
15.	**16.**	**17.**	**18.**	**19.**	**20.**
$9\frac{3}{4}$	$9\frac{3}{4}$	$9\frac{1}{4}$	$8\frac{1}{4}$	$15\frac{1}{4}$	$36\frac{1}{4}$
$2\frac{1}{4}$	$2\frac{3}{4}$	$2\frac{3}{4}$	$1\frac{3}{4}$	$2\frac{3}{4}$	$22\frac{3}{4}$

Further Work in Subtracting Fractions. **1.** In making a picture frame Louis cut a piece of molding $5\frac{3}{8}$ in. long from a piece $8\frac{7}{8}$ in. long. How long was the piece that was left?

We see that $8\frac{7}{8} - 5\frac{3}{8} = 3\frac{4}{8} = 3\frac{1}{2}$.

That is, Louis has $3\frac{1}{2}$ in. of molding left.

2. How much picture molding will Louis have left if he takes $2\frac{3}{4}$ in. from $8\frac{1}{2}$ in.?

We must subtract $2\frac{3}{4}$ from $8\frac{1}{2}$.

We see that $\frac{3}{4}$ is greater than $\frac{1}{2}$, and so we cannot take $\frac{3}{4}$ from $\frac{1}{2}$.

We see that $8\frac{1}{2} = 7 + 1\frac{1}{2} = 7\frac{3}{2}$.

We know that $\frac{3}{2} = \frac{6}{4}$.

So we can take $2\frac{3}{4}$ from $7\frac{6}{4}$.

The result is $5\frac{3}{4}$, and so Louis has $5\frac{3}{4}$ in. left.

$$\begin{array}{r} 8\frac{1}{2} = 7\frac{3}{2} = 7\frac{6}{4} \\ 2\frac{3}{4} = 2\frac{3}{4} = 2\frac{3}{4} \\ \hline 5\frac{3}{4} \end{array}$$

WRITTEN EXERCISE

1. If from 10 yd. of cloth we cut $2\frac{1}{2}$ yd., how much cloth is left?

2. If from 15 yd. of ribbon we cut $5\frac{3}{4}$ yd. and $1\frac{1}{2}$ yd., how much ribbon is left?

3. How much picture molding will Louis have left if he takes $2\frac{7}{8}$ in. from 8 in.?

Subtract the following:

4. $5\frac{1}{3} - \frac{2}{3}$.
5. $7\frac{3}{8} - \frac{7}{8}$.
6. $5\frac{1}{4} - 3$.
7. $6 - 2\frac{1}{4}$.
8. $5 - 1\frac{1}{2}$.
9. $7 - 3\frac{1}{4}$.
10. $12 - 2\frac{3}{4}$.
11. $10 - 3\frac{2}{3}$.
12. $2 - \frac{3}{4}$.
13. $5\frac{1}{4} - 3\frac{1}{2}$.
14. $8\frac{1}{2} - 3\frac{1}{4}$.
15. $5\frac{1}{2} - 2\frac{3}{4}$.
16. $7\frac{1}{2} - 5\frac{3}{4}$.
17. $8\frac{1}{2} - 4\frac{3}{4}$.
18. $9\frac{3}{8} - 5\frac{3}{4}$.
19. $8\frac{1}{8} - 2\frac{1}{2}$.

ORAL EXERCISE

1. If from $\frac{7}{8}$ yd. we take $\frac{3}{8}$ yd., how much is left?

2. If from a board $\frac{15}{16}$ in. thick we plane off $\frac{3}{16}$ in., how thick is the board then?

3. If a notebook is $\frac{7}{12}$ in. thick and the cover is $\frac{1}{12}$ in. thick, how thick is the book without the cover?

Subtract the following:

4.	$\frac{3}{4}-\frac{1}{4}$	$\frac{3}{8}-\frac{1}{8}$	$\frac{5}{8}-\frac{1}{8}$	$\frac{5}{8}-\frac{3}{8}$
5.	$\frac{7}{8}-\frac{1}{8}$	$\frac{7}{8}-\frac{3}{8}$	$\frac{7}{8}-\frac{5}{8}$	$\frac{9}{8}-\frac{7}{8}$
6.	$\frac{5}{6}-\frac{1}{6}$	$\frac{5}{5}-\frac{1}{5}$	$\frac{5}{4}-\frac{2}{4}$	$\frac{6}{5}-\frac{4}{5}$

7. How do you subtract one fraction from another when the two fractions have different denominators?

WRITTEN EXERCISE

Subtract the following:

1.	$5\frac{2}{3}-2\frac{1}{3}$.	5.	$6\frac{1}{2}-5\frac{5}{12}$.
2.	$7\frac{1}{2}-3\frac{1}{4}$.	6.	$5\frac{7}{8}-3\frac{1}{4}$.
3.	$2\frac{1}{2}-2\frac{1}{4}$.	7.	$8\frac{5}{8}-2\frac{1}{2}$.
4.	$3\frac{5}{8}-2\frac{1}{2}$.	8.	$6\frac{5}{6}-3\frac{1}{3}$.
9.	$19-3\frac{4}{5}$.		
10.	$15-7\frac{11}{12}$.		
11.	$6\frac{4}{5}-3\frac{1}{5}$.		
12.	$8\frac{1}{2}-6\frac{2}{3}$.		

13. If from a board $\frac{7}{8}$ in. thick we plane off $\frac{1}{4}$ in., how thick is the board then?

14. If we cut from 10 yd. of cloth $2\frac{1}{2}$ yd. and $3\frac{1}{2}$ yd., how much cloth is left?

15. If we cut from 15 yd. of ribbon $1\frac{1}{2}$ yd., $3\frac{1}{2}$ yd., $2\frac{1}{2}$ yd., $5\frac{1}{2}$ yd., and $1\frac{1}{2}$ yd., how much ribbon is left?

IX. BILLS AND RECEIPTS

Making out Bills. To *foot a bill* means to add the amounts and find the total cost. To *receipt a bill* means to stamp or write the words "Paid" or "Received Payment," followed by the date and by the name of the one to whom payment is due. This is a receipted bill:

CHARLES DUNHAM

New York, March 1, 1919

Sold to Mr. David Brownson

Feb.	*5*	*6 cans soup* .20	*1*	*20*

RECEIPTED
MAR. 3, 1919
CHARLES DUNHAM
Per A. E. B.

Study the bill and answer these questions: What does the 20 mean? What is the amount of the bill? When were the goods bought? When was the bill paid? What does the receipt show?

The teacher should encourage the pupils to make out bills of goods at prices current in the place where they live. The meaning of the term "debtor" and the abbreviation "Dr." should be explained.

The class should be asked the meaning of "charging" purchases, and of having an account at a store. The advantages and disadvantages of cash payments should be explained.

WRITTEN EXERCISE

Copy, fill, foot, and receipt each of the following bills, dating it and the receipt at the place where you live, and signing your name as the clerk who received the money:

1.

GEORGE HALL

Sold to Mr. Robert Lee

Jan.	*2*	*9 doz. eggs*	*.32*		
		9 lb. butter	*.33*		
	5	*6 lb. cheese*	*.22*		

Received Payment

George Hall

By John Jewett

2.

B. S. OSBORNE & CO.

Sold to Mr. James Keene

Oct.	*3*	*12 yd. silk*	*1.00*		
		9 yd. lace	*.75*		
		8 yd. ribbon	*.30*		

3.

McCLINTOCK & CO.

Sold to Mr. R. S. Bell

Apr.	*6*	*3 yd. silk*	*.80*		
		2 doz. buttons	*.45*		
	15	*12 yd. calico*	*.07*		
		5 yd. lace	*.40*		
May	*10*	*9 yd. linen*	*.60*		
		2 yd. ribbon	*.75*		

Copy, fill, foot, and receipt the following, as on page 152:

4.

[*Name*]....., Dealer in Meats and Poultry

[*Name of place, and date*].....19.....

Sold to M.....[*Name*].....

....[*Date*]....	*6 lb. roast beef*	*.34*		
"	*6 lb. chicken*	*.25*		
	[*Receipt*].....			

5.

[*Insert name of some grocer*]....., Grocer

[*Name of place, and date*].....19.....

Sold to M.....[*Name*].....

....[*Date*]....	*4 lb. powdered sugar*	*.07*		
"	*3 doz. eggs*	*.35*		
"	*½ doz. oranges*	*.60*		
	[*Receipt*].....			

6.

[*Name*]....., Grocer

[*Name of place, and date*].....19.....

Sold to M.....[*Name*].....

....[*Date*]....	*2 heads lettuce*	*.05*		
"	*6 lb. butter*	*.32*		
"	*4 gal. oil*	*.18*		
"	*8 lb. raisins*	*.12*		
"	*3 lb. coffee*	*.30*		
	[*Receipt*].....			

WRITTEN EXERCISE

Make out bills for the following, giving names and dates:

1. 15 lb. granulated sugar @ 5¢, 3 pk. fancy potatoes @ 25¢, 4 cans salmon @ 8¢.

2. 7 lb. butterine @ 25¢, 4 jars New Orleans molasses @ 20¢, 2 packages raisins @ 9¢, 5 boxes matches @ 4¢.

3. 84 gro. bone buttons @ 18¢, 694 yd. cambric @ 17¢, 72 doz. pearl buttons @ 9¢, 364 yd. cashmere @ 82¢.

12 dozen = 1 gross (gro.). Therefore 144 = 1 gro.

4. 8 doz. combs @ $1.95, 4 doz. brushes @ $18.37, 3 doz. atomizers @ $19.25, 4 gro. toothbrushes @ $9.35, $\frac{1}{2}$ gro. nailbrushes @ $27.50.

5. 480 yd. matting @ 18¢, 375 yd. matting @ 19¢, 284 yd. carpet @ 48¢, 8 rugs @ $7.33, 4 doz. doormats @ $6.75, 185 yd. carpet @ 65¢.

6. 9 dining-room sets @ $62.50, 16 rockers @ $5.35, 8 sideboards @ $32.50, 6 card tables @ $8.75, 4 china closets @ $17.50.

7. 325 yd. carpet @ 48¢, 520 yd. matting @ 22¢, 16 rugs @ $6.40, 4 rugs @ $12.50, 3 doz. doormats @ $7.30, 328 yd. calico @ 6¢.

8. 8 doz. hatchets @ $10.75, 6 doz. pairs hinges @ $4.35, 5 doz. carpenter's squares @ $34.50, $\frac{1}{2}$ gro. locks @ $42.50, 8 doz. files @ $6.25.

9. 75 M (75,000) envelopes @ $2.30, 75 lb. paper @ 22¢, 4 doz. fountain pens @ $23.50, 10 doz. bottles ink @ 42¢, 6 dictionaries @ $5.50.

X. USING WHAT YOU HAVE LEARNED

TAKING A TRIP

1. Fred's father took him on a trip from New York to Philadelphia. They left at half past nine in the morning

and arrived at half past eleven. How long were they in taking the trip?

2. It is 58 mi. from New York to Trenton, and 34 mi. from Trenton to Philadelphia. How many miles long is the trip that Fred and his father took to Philadelphia?

3. If Fred's father paid 90¢ for a taxi ride and 20¢ extra for baggage, how much did he pay in all?

4. They bought, for luncheon on the train, 8 sandwiches at 10¢ each, half a dozen cookies at 10¢ a dozen, and 4 oranges at 5¢ each. How much did the luncheon cost?

THE SURPRISE PARTY

1. Fanny will be 9 years old next week, and the class is going to give her a surprise party. There are 17 boys and 19 girls. The boys agree to put in 15¢ apiece and the girls 10¢ apiece. How much will all the boys put in? How much will all the girls put in?

2. How much money will all the boys and girls put in for Fanny's surprise party in Ex. 1?

3. The children decide to take out 75¢ for flowers. How much does that leave?

4. With what is left, after taking out the money for the flowers, they think of buying a present for Fanny. They spend some of the money, however, for candles for the cake, and have $3.50 left. How much did they spend for candles?

5. They priced a watch and found that this would use half of the $3.50. What was the price of the watch? If they buy it, how much money will they have left?

6. They bought the watch and then bought a silver bracelet for $1.50, and decided to give the rest to a poor woman whom Fanny liked. How much money did they give to the woman?

7. At the night of the party each of the 19 girls took 4 little cakes to the party. How many did they all take?

8. Since the boys wanted to do their share, each one took 6 apples. How many apples did the 17 boys take?

Pupils find it interesting and valuable to make up such sets of problems occasionally.

MINIMUM ESSENTIALS

WHEN YOU FINISH THIS BOOK YOU SHOULD BE ABLE TO ADD QUICKLY AND ACCURATELY

Copy and add, timing yourself on each set of ten:

1. 4136 + 9287.
2. 3092 + 4768.
3. 4381 + 8092.
4. 5276 + 8397.
5. 4855 + 8762.
6. 3984 + 9876.
7. 8237 + 4583.
8. 5692 + 8173.
9. 8494 + 9877.
10. 4086 + 3790.
11. 6842 + 9382.
12. 7209 + 9089.
13. 8778 + 8296.
14. 4009 + 8999.
15. 6872 + 1983.
16. 5273 + 8556.
17. 4196 + 3784.
18. 5243 + 4876.
19. $52.43 + $48.76.
20. $524.30 + $48.76.
21. 8179 + 9283.
22. $81.79 + $92.83.
23. $817.90 + $928.30.
24. $54.62 + $87.96.
25. 778 + 896 + 408.
26. 539 + 683 + 997.
27. $5.28 + $4.96 + $3.74.
28. $128.90 + $34.76 + $48.23.
29. $12.89 + $34.76 + $48.23.
30. $12.89 + $347.60 + $428.30.

Efficiency tests of this kind are helpful throughout the course, and many of them are provided in this book. They may be used for drill purposes at any time.

YOU SHOULD SUBTRACT QUICKLY AND ACCURATELY

Copy and subtract, timing yourself on each set of ten:

1. 7830 − 4296.
2. 8132 − 3894.
3. 6209 − 4836.
4. 7108 − 2987.
5. 5633 − 1987.
6. 4206 − 1899.
7. 3837 − 1968.
8. 9001 − 2983.
9. 8002 − 3093.
10. 6277 − 4968.
11. 5307 − 2836.
12. 6612 − 4833.
13. 4702 − 3685.
14. 5211 − 2033.
15. 4787 − 2939.
16. 2192 − 1998.
17. 6070 − 3841.
18. 5791 − 2992.
19. 6280 − 5691.
20. 2936 − 1987.
21. $129.60 − $13.48.
22. $128.30 − $26.37.
23. $201.40 − $52.33.
24. $280.30 − $29.46.
25. $310.02 − $38.36.
26. $401.01 − $56.75.
27. $126.37 − $109.48.
28. $630.02 − $427.63.
29. $702.23 − $426.48.
30. $523.41 − $239.68.
31. $429.83 − $327.60.
32. $527.75 − $209.09.
33. $607.07 − $421.36.
34. $528.28 − $492.99.
35. $800.70 − $528.36.
36. $602.73 − $478.64.
37. $281.32 − $193.82.
38. $1026.00 − $873.75.
39. $2000.00 − $1482.60.
40. $2172.30 − $1986.45.

In computing the time, the pupil should include the time of copying. In practical business we have to write the numbers as well as subtract them, and this is part of the training. The pupil should learn to write the numbers neatly and accurately as well as quickly.

YOU SHOULD MULTIPLY QUICKLY AND ACCURATELY

Copy and multiply, timing yourself on each set of ten:

1. 29×38.	21. 121×342.	41. $52 \times \$48.72$.
2. 42×70.	22. 426×809.	42. $73 \times \$96.80$.
3. 63×96.	23. 707×556.	43. $65 \times \$40.75$.
4. 45×84.	24. 432×487.	44. $87 \times \$36.42$.
5. 32×29.	25. 562×809.	45. $54 \times \$80.92$.
6. 86×98.	26. 977×844.	46. $39 \times \$78.82$.
7. 70×93.	27. 555×876.	47. $46 \times \$68.08$.
8. 80×90.	28. 743×201.	48. $67 \times \$98.74$.
9. 68×86.	29. 529×826.	49. $89 \times \$56.43$.
10. 44×88.	30. 432×481.	50. $78 \times \$80.96$.
11. 14×236.	31. 26×3478.	51. $215 \times \$2.78$.
12. 43×309.	32. 43×8296.	52. $328 \times \$3.46$.
13. 57×877.	33. 21×8477.	53. $756 \times \$4.09$.
14. 92×379.	34. 30×9872.	54. $642 \times \$9.81$.
15. 64×909.	35. 62×8907.	55. $877 \times \$8.75$.
16. 83×888.	36. 48×7460.	56. $48 \times \$21.36$.
17. 47×926.	37. 38×9080.	57. $37 \times \$92.08$.
18. 35×875.	38. 65×2178.	58. $56 \times \$90.09$.
19. 44×557.	39. 36×8472.	59. $78 \times \$89.86$.
20. 63×892.	40. 27×9628.	60. $96 \times \$86.79$.

In giving such efficiency tests the teacher may find it of advantage to give on one day Exs. 1–10 on page 157, Exs. 1–10 on page 158, Exs. 1–10 on page 159, and so on; and on another day Exs. 11–20 on the same pages.

YOU SHOULD DIVIDE QUICKLY AND ACCURATELY

Copy and divide, writing both quotient and remainder, timing yourself on each set of ten:

1. $428 \div 26$.	**21.** $2173 \div 42$.	**41.** $\$144 \div 12$.
2. $378 \div 24$.	**22.** $5683 \div 85$.	**42.** $\$288 \div 24$.
3. $526 \div 28$.	**23.** $8093 \div 92$.	**43.** $\$17.28 \div 4$.
4. $875 \div 43$.	**24.** $9062 \div 77$.	**44.** $\$17.28 \div 12$.
5. $920 \div 37$.	**25.** $8112 \div 92$.	**45.** $\$17.28 \div 24$.
6. $801 \div 49$.	**26.** $3984 \div 46$.	**46.** $\$13.31 \div 11$.
7. $676 \div 33$.	**27.** $5085 \div 70$.	**47.** $\$70.07 \div 11$.
8. $494 \div 19$.	**28.** $3700 \div 69$.	**48.** $\$2626 \div 13$.
9. $962 \div 32$.	**29.** $4008 \div 90$.	**49.** $\$2756 \div 13$.
10. $488 \div 27$.	**30.** $7782 \div 56$.	**50.** $\$4575 \div 25$.
11. $1283 \div 38$.	**31.** $5434 \div 82$.	**51.** $\$1270 \div 12$.
12. $4072 \div 56$.	**32.** $4848 \div 49$.	**52.** $\$3250 \div 14$.
13. $5710 \div 29$.	**33.** $6209 \div 80$.	**53.** $\$1236 \div 21$.
14. $8209 \div 37$.	**34.** $5000 \div 91$.	**54.** $\$2238 \div 33$.
15. $9108 \div 43$.	**35.** $3707 \div 86$.	**55.** $\$4756 \div 42$.
16. $9807 \div 46$.	**36.** $5200 \div 35$.	**56.** $\$40.20 \div 45$.
17. $5055 \div 75$.	**37.** $4801 \div 29$.	**57.** $\$50.05 \div 72$.
18. $8026 \div 93$.	**38.** $8237 \div 92$.	**58.** $\$61.72 \div 36$.
19. $9071 \div 85$.	**39.** $5781 \div 86$.	**59.** $\$48.56 \div 29$.
20. $9002 \div 96$.	**40.** $4000 \div 99$.	**60.** $\$37.92 \div 18$.

In practical work in division there is usually a remainder. At present the pupil should merely indicate the remainder or write a common fraction in the quotient.

YOU SHOULD QUICKLY AND ACCURATELY REDUCE, ADD, AND SUBTRACT THE ORDINARY FRACTIONS OF BUSINESS, AND FIND FRACTIONAL PARTS OF WHOLE NUMBERS

Copy, and perform the operations indicated, timing yourself on each set of ten:

1. $\frac{2}{3} = \frac{\quad}{6}$.
2. $\frac{3}{4} = \frac{\quad}{8}$.
3. $\frac{1}{2} = \frac{\quad}{4}$.
4. $\frac{1}{8} = \frac{\quad}{16}$.
5. $\frac{3}{8} = \frac{\quad}{16}$.
6. $\frac{1}{4} = \frac{\quad}{8}$.
7. $\frac{1}{2} = \frac{\quad}{8}$.
8. $\frac{1}{3} = \frac{\quad}{9}$.
9. $\frac{5}{8} = \frac{\quad}{16}$.
10. $\frac{7}{8} = \frac{\quad}{32}$.
11. $\frac{1}{2} + \frac{3}{8}$.
12. $\frac{3}{4} + \frac{1}{8}$.
13. $\frac{3}{4} + \frac{7}{8}$.
14. $\frac{5}{8} + \frac{1}{2}$.
15. $\frac{7}{8} + \frac{1}{2}$.
16. $1\frac{1}{2} \times 6$.
17. $1\frac{2}{3} \times 9$.
18. $2\frac{1}{2} \times 8$.
19. $2\frac{1}{3} \times 12$.
20. $2\frac{5}{6} \times 12$.
21. $\frac{1}{2} - \frac{1}{4}$.
22. $\frac{3}{4} - \frac{1}{2}$.
23. $\frac{1}{2} - \frac{1}{8}$.
24. $\frac{1}{2} - \frac{3}{8}$.
25. $\frac{5}{8} - \frac{1}{2}$.
26. $\frac{5}{8} - \frac{1}{4}$.
27. $\frac{3}{4} - \frac{5}{8}$.
28. $\frac{7}{8} - \frac{1}{4}$.
29. $\frac{7}{8} - \frac{1}{2}$.
30. $\frac{7}{8} - \frac{3}{4}$.
31. $\frac{5}{9} - \frac{1}{3}$.
32. $\frac{7}{9} - \frac{2}{3}$.
33. $\frac{1}{2} + \frac{1}{4} + \frac{1}{8}$.
34. $\frac{1}{2} + \frac{3}{4} + \frac{1}{8}$.
35. $\frac{1}{2} + \frac{1}{4} + \frac{3}{8}$.
36. $\frac{1}{2} + \frac{3}{4} + \frac{3}{8}$.
37. $\frac{1}{2} + \frac{1}{4} + \frac{5}{8}$.
38. $\frac{1}{2} + \frac{3}{4} + \frac{5}{8}$.
39. $\frac{1}{2} + \frac{1}{4} + \frac{7}{8}$.
40. $\frac{1}{2} + \frac{3}{4} + \frac{7}{8}$.
41. $\frac{1}{2}$ of 428.
42. $\frac{1}{3}$ of 828.
43. $\frac{2}{3}$ of 624.
44. $\frac{1}{4}$ of 624.
45. $\frac{3}{4}$ of 736.
46. $\frac{1}{8}$ of 968.
47. $\frac{3}{8}$ of 256.
48. $\frac{5}{8}$ of 496.
49. $\frac{7}{8}$ of 584.
50. $\frac{3}{5}$ of 475.
51. $3\frac{3}{4} + 2\frac{1}{2}$.
52. $3\frac{3}{4} - 2\frac{1}{2}$.
53. $4\frac{3}{8} + 3\frac{1}{2}$.
54. $4\frac{3}{8} - 3\frac{1}{2}$.
55. $6\frac{2}{3} + 2\frac{1}{6}$.
56. $6\frac{2}{3} - 2\frac{1}{6}$.
57. $4\frac{3}{8} + 1\frac{1}{4}$.
58. $4\frac{3}{8} - 1\frac{1}{4}$.
59. $7\frac{1}{2} + 2\frac{1}{4}$.
60. $7\frac{1}{2} - 2\frac{1}{4}$.

COMMON MEASURES, AND HOW TO USE THEM

Copy, and complete each statement, timing yourself on each set of ten:

1. 1 ft. = (?) in.
2. 7 ft. = (?) in.
3. 9 ft. = (?) in.
4. 1 yd. = (?) ft.
5. 7 yd. = (?) ft.
6. $3\frac{1}{2}$ yd. = (?) ft.
7. 1 yd. = (?) in.
8. $2\frac{1}{2}$ yd. = (?) in.
9. 8 yd. = (?) ft.
10. 36 in. = (?) ft.
11. 27 ft. = (?) yd.
12. 99 ft. = (?) yd.
13. 1 mi. = (?) ft.
14. 4 mi. = (?) ft.
15. 1 mi. = (?) yd.
16. $\frac{1}{2}$ mi. = (?) yd.
17. $1\frac{1}{2}$ mi. = (?) ft.
18. $3\frac{1}{4}$ mi. = (?) ft.
19. $\frac{2}{3}$ mi. = (?) ft.
20. $\frac{3}{4}$ mi. = (?) ft.
21. 1 lb. = (?) oz.
22. $\frac{3}{4}$ lb. = (?) oz.
23. $2\frac{1}{2}$ lb. = (?) oz.
24. 16 oz. = (?) lb.
25. 144 oz. = (?) lb.
26. 288 oz. = (?) lb.
27. 1 T. = (?) lb.
28. $3\frac{1}{2}$ T. = (?) lb.
29. 1 qt. = (?) pt.
30. $7\frac{1}{2}$ qt. = (?) pt.
31. 1 gal. = (?) qt.
32. $3\frac{3}{4}$ gal. = (?) qt.
33. $4\frac{3}{4}$ gal. = (?) pt.
34. 1 bu. = (?) pk.
35. $7\frac{1}{2}$ bu. = (?) pk.
36. 1 pk. = (?) qt.
37. $5\frac{1}{2}$ pk. = (?) qt.
38. 7 sq. ft. = (?) sq. in.
39. 7 sq. yd. = (?) sq. ft.
40. 7 hr. = (?) min.

Teachers should remember that we no longer use such numbers as 4 mi. 3 yd. 2 ft. 2 in. We use not more than two denominations.

LITTLE EXAMINATIONS

I.
1. $4856 + 9237$.
2. $7902 - 5919$.
3. $\$40.73 + \$20.96$.
4. $\$50.13 - \$32.75$.
5. $7 \times \$2.96$.
6. $300 \times \$1.75$.
7. $72 \times \$3.75$.
8. 475×582.
9. $25{,}984 \div 58$.
10. 8 lb. = (?) oz.

II.
1. $8346 + 9078$.
2. $3709 - 2963$.
3. $\$30.82 + \$52.86$.
4. $\$52.32 - \$29.56$.
5. $8 \times \$2.85$.
6. $400 \times \$2.40$.
7. $38 \times \$4.22$.
8. 287×496.
9. $7500 \div 125$.
10. 4 sq. ft. = (?) sq. in.

III.
1. $4283 + 6296$.
2. $4132 - 2876$.
3. $\$40.27 + \$32.96$.
4. $\$60.01 - \$19.83$.
5. $9 \times \$3.27$.
6. $520 \times \$3.04$.
7. $68 \times \$5.37$.
8. 394×498.
9. $14{,}500 \div 125$.
10. 288 sq. in. = (?) sq. ft.

IV.
1. $7129 + 3786$.
2. $5235 - 2868$.
3. $\$23.49 + \$87.62$.
4. $\$52.29 - \$26.60$.
5. $6 \times \$4.72$.
6. $760 \times \$4.60$.
7. $49 \times \$7.72$.
8. 778×642.
9. $38{,}802 \div 116$.
10. 9 sq. ft. = (?) sq. in.

V. 1. 29,732 + 34,821.
2. 61,241 − 48,327.
3. \$52.75 + \$96.54.
4. \$91.16 − \$57.83.
5. 270 × \$52.60.
6. 678 × 9561.
7. 18,275 ÷ 25.
8. 15 sq. ft. = (?) sq. in.
9. 63 sq. ft. = (?) sq. yd.
10. $\frac{7}{8}$ of 1760.

VI. 1. 43,729 + 68,456.
2. 81,231 − 36,493.
3. \$78.29 + \$96.48.
4. \$130 − \$75.25.
5. 24 × \$48.75.
6. 426 × \$2.50.
7. 21,250 ÷ 25.
8. 17 sq. ft. = (?) sq. in.
9. 432 sq. in. = (?) sq. ft.
10. $\frac{7}{10}$ of 21,150.

VII. 1. 72,381 + 96,409.
2. 72,381 − 67,409.
3. \$63.09 + \$42.76.
4. \$29.11 − \$16.75.
5. 56 × \$27.50.
6. 575 × \$23.55.
7. 42,650 ÷ 50.
8. 17 lb. = (?) oz.
9. 32 oz. = (?) lb.
10. $\frac{5}{12}$ of 108.

VIII. 1. 53,489 + 71,268.
2. 49,314 − 36,928.
3. \$78.96 + \$43.58.
4. \$127.50 − \$9.75.
5. 196 × \$7.52.
6. 456 × 8723.
7. 57,960 ÷ 40.
8. 16 bu. = (?) pk.
9. 32 pk. = (?) bu.
10. $\frac{11}{12}$ of 14,520.

IX. 1. 82,371 + 58,876.
2. 65,811 − 32,929.
3. \$94.57 + \$91.83.
4. \$81.22 − \$54.55.
5. 287 × \$8.95.
6. 298 × \$43.80.
7. 396 × 4716.
8. 22 gal. = (?) qt.
9. 124 qt. = (?) gal.
10. $\frac{5}{8}$ of 6512.

TABLES FOR REFERENCE

Length

12 inches (in.) = 1 foot (ft.)
3 feet = 1 yard (yd.)
5280 feet = 1 mile (mi.)

Square Measure

144 square inches (sq. in.) = 1 square foot (sq. ft.)
9 square feet = 1 square yard (sq. yd.)

Weight

16 ounces (oz.) = 1 pound (lb.)
2000 pounds = 1 ton (T.)

Liquid Measure

2 pints (pt.) = 1 quart (qt.)
4 quarts = 1 gallon (gal.)

Dry Measure

2 pints (pt.) = 1 quart (qt.)
8 quarts = 1 peck (pk.)
4 pecks = 1 bushel (bu.)

Time

60 seconds (sec.) = 1 minute (min.)
60 minutes = 1 hour (hr.)
24 hours = 1 day (da.)
7 days = 1 week (wk.)
About 4 weeks = 1 month (mo.)
12 months = 1 year (yr.)

Multiplication Table

$1\times2=2$	$1\times3=3$	$1\times4=4$	$1\times5=5$
$2\times2=4$	$2\times3=6$	$2\times4=8$	$2\times5=10$
$3\times2=6$	$3\times3=9$	$3\times4=12$	$3\times5=15$
$4\times2=8$	$4\times3=12$	$4\times4=16$	$4\times5=20$
$5\times2=10$	$5\times3=15$	$5\times4=20$	$5\times5=25$
$6\times2=12$	$6\times3=18$	$6\times4=24$	$6\times5=30$
$7\times2=14$	$7\times3=21$	$7\times4=28$	$7\times5=35$
$8\times2=16$	$8\times3=24$	$8\times4=32$	$8\times5=40$
$9\times2=18$	$9\times3=27$	$9\times4=36$	$9\times5=45$
$10\times2=20$	$10\times3=30$	$10\times4=40$	$10\times5=50$
$11\times2=22$	$11\times3=33$	$11\times4=44$	$11\times5=55$
$12\times2=24$	$12\times3=36$	$12\times4=48$	$12\times5=60$

$1\times6=6$	$1\times7=7$	$1\times8=8$	$1\times9=9$
$2\times6=12$	$2\times7=14$	$2\times8=16$	$2\times9=18$
$3\times6=18$	$3\times7=21$	$3\times8=24$	$3\times9=27$
$4\times6=24$	$4\times7=28$	$4\times8=32$	$4\times9=36$
$5\times6=30$	$5\times7=35$	$5\times8=40$	$5\times9=45$
$6\times6=36$	$6\times7=42$	$6\times8=48$	$6\times9=54$
$7\times6=42$	$7\times7=49$	$7\times8=56$	$7\times9=63$
$8\times6=48$	$8\times7=56$	$8\times8=64$	$8\times9=72$
$9\times6=54$	$9\times7=63$	$9\times8=72$	$9\times9=81$
$10\times6=60$	$10\times7=70$	$10\times8=80$	$10\times9=90$
$11\times6=66$	$11\times7=77$	$11\times8=88$	$11\times9=99$
$12\times6=72$	$12\times7=84$	$12\times8=96$	$12\times9=108$

SUGGESTIONS TO TEACHERS

In this, the last year of the primary grades, it is well to feel sure that the essentials of arithmetic have all been touched upon. It is therefore necessary to review the four fundamental operations, extending the multiplication and division work to include three-figure multipliers and divisors. The common business fractions are also included, with simple operations as far as the addition and subtraction of fractions which are easily reduced to common denominators. If a child does not know the four operations with integers at the end of this year, he will have trouble with his arithmetic always thereafter; and if he does not know how to handle the addition and subtraction of fractions, at least to eighths, with ease, he will be much hampered in his subsequent work. This is a period of habit-formation in the child's life, and advantage must be taken of this fact to form good habits in numerical calculation that will remain with him through life.

In this year the numbers extend to 1,000,000. The operations, however, should be confined to small numbers that enter into such business matters as can be appreciated by children of this age.

The work in common fractions should be confined to fractions that are needed in ordinary business, and chiefly to those with denominators 2, 3, 4, and 8. Of course there is no objection to an occasional example with denominators of two or three figures, but the day of fractions like $\frac{2}{12}\frac{4}{8}\frac{3}{4}$ is past, decimal fractions having taken the place of all such forms.

As stated in the Preface, the work of Grade IV is a summary of the essentials of arithmetic. The essentially new features are long division, a critical point in the teaching of arithmetic and one which is treated with unusual care in this book, and the addition

and subtraction of fractions. In every subject the pupil is carried farther than in the preceding grades, and when he finishes this book he is fairly well prepared for the computations which he will meet in ordinary business.

The great test of teaching in this grade is the ability to hold the interest of the pupils in the review work. All city courses of study are more or less spiral in arrangement, that is, they go over the fundamental operations several times, and it requires some tact and skill to keep the child's interest. This can be done only by showing him that he is learning more and more about the subjects which he actually uses in his necessary computations.

Drills and reviews by the use of games and dramatized occupations are valuable in this grade. Keep these simple and keep the mathematics prominent. The following list of games may be helpful to the teacher: mora, dominoes, teetotum games, peggy, lotto (both games), flinch, shuffleboard, Simon says "Thumbs up," tag, hide and seek, arithmetic standards, guessing, climb the ladder, roll the hoop, railroad train, blackboard relay, cross questions, and other games already mentioned, together with magic squares, selections from number curiosities, and tests of divisibility, easy puzzles, and dramatized occupations.

The attention of teachers is called particularly to the extensive efficiency tests on pages 157–162, and to the desirability of using such tests from time to time, the pupils keeping their score cards and seeking to improve upon their previous records in the same test. The teacher should find, as a result of these score cards, the time to be allowed for the work. This varies, depending somewhat upon the difficulties with language in some of the city schools.

The teacher should remember that the aims of teaching arithmetic during the first four years are the mastery of the fundamental processes involving integers, the security of facility in calculation, the treatment of simple fractions as equal parts of small numbers, and the simple application of whole numbers and easy fractions to the problems of everyday occurrence.

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